

FM 1-140

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HELICOPTER GUNNERY

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GUNNERY****FM1-140****CONTENTS**

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PREFACE

Successful mission accomplishment on today's air-land battlefield requires that attack helicopter crews place effective fire on the enemy without being destroyed themselves. The key to effective helicopter gunnery is a realistic training program. This manual recommends an aerial gunnery training program that enables a unit to attain and maintain combat proficiency. Aerial gunnery tables for qualification and continuation training of crews and teams are included. Examples are given of aerial gunnery skills tests, score-cards, and range layouts for an aerial gunnery program.

The purpose of this field manual is to improve the ability of the helicopter crew to place rounds on the target rapidly and accurately. This includes mastering basic aircraft flying techniques, target detection skills, and accurate range estimation. It also includes using sound judgment in selecting techniques and methods of engagement.

This manual explains the fundamentals of ballistics as applied to helicopter gunnery. This includes classifications, descriptions, and interaction of projectiles with air masses. The manual also describes the types and modes of fire used with the various weapon subsystems of attack and utility helicopters and establishes methods of adjusting indirect fire.

Additional guidance on the combined arms team's combat mission and its execution can be found in FM 100-5. FM 1-100 is the keystone manual for employment of aviation. Specific guidance on employment and mission execution of combat aviation units may be found in other publications listed in FM 1-100.

This publication is intended for commanders and staffs and all other personnel involved in coordinating, planning, and executing attack helicopter gunnery or aerial door gunnery. The publication contains technical material such as that on weapon systems of attack and utility helicopters.

The proponent of this publication is HQ TRADOC. Submit changes for improving this publication on DA Form 2028 (Recommended Changes to Publications and Blank Forms), and forward it to Commander, United States Army Aviation Center and Fort Rucker, ATTN: ATZQ-TDD, Fort Rucker, AL 36362-5000.

The provisions of this publication are the subject of international agreements:

STANAGs

***2951 (QSTAG 769) Non-Electronic Communications for
 Helicopters***

3117 (Air Std 44/42) Aircraft Marshalling Signals

Unless otherwise stated, whenever the masculine gender is used, both men and women are included.

This publication has been reviewed for OPSEC considerations.

CHAPTER 1

INTRODUCTION

This field manual explains the fundamentals of ballistics and techniques, various types, and modes of fire. It recommends an aerial gunnery program and describes the characteristics of aerial weapon systems for all attack platforms. This manual also provides updated aerial gunnery tables for qualification and continuation training and discusses current and future training devices being fielded to assist in gunnery training. In addition, it describes administration and logistical considerations required for the training program.

1-1. STANDARDS IN TRAINING COMMISSION PROGRAM

a. STRAC was developed to determine the quantities and type of munitions essential for soldiers, crews, and units to attain and sustain weapon proficiency. STRAC emphasizes making maximum use of training aids, devices, simulators, and subcaliber firing.

b. The ammunition authorizations as prescribed by STRAC are the maximum amounts authorized per airframe. These authorizations are determined by the training readiness condition of the unit. Commanders should evaluate their training programs to ensure maximum qualification and continuation training with the ammunition available.

1-2. AVIATOR PROGRESSION

a. Initial training of attack pilots is conducted in one of the attack helicopter Aviator Qualification Courses at Fort Rucker, Alabama. Pilots who successfully complete AQC are considered qualified on individual tables. They will not be required to execute individual tables upon arrival at their unit. Newly qualified aviators should commence training as part of a crew or team at the discretion of the commander.

b. Once established in the unit's gunnery program, aviators should maintain a level of proficiency designated by the commander. Commanders should strive to maintain personnel at team level.

c. Unit trainers should play an integral role in the unit's gunnery program. In addition to possessing a thorough knowledge of aircraft weapon systems, UTs are highly skilled in

instructional techniques. This reduces the work load of instructor pilots during gunnery exercises. In selecting UTs, commanders should consider this as a possible grooming stage before IP selection.

1-3. TRAINING STRATEGY

a. The commander develops the training strategy for aerial gunnery. This allows him to attain and maintain the unit's gunnery program at a designated level based on the unit's mission and availability of resources. The gunnery program begins with individual training—conducted at Fort Rucker—and progresses to a maintainable level, preferably team, appropriate for the unit's mission.

b. It is unrealistic and wasteful for a unit to begin each qualification or gunnery-training cycle at ground zero. The unit's level of proficiency should be maintained from the previous year, considering personnel changes and ammunition and range constraints. Additionally, proficiency levels of experienced aviators must be recognized. The gunnery program must be flexible to avoid the redundancy of live-fire training of basic tasks. This should not, however, excuse gunnery-proficient aviators from taking part in aerial gunnery skills test training before each range. These personnel may assist IPs/UTs in training those individuals who are not as proficient in AGST tasks.

c. Commanders must be flexible in their continuation training program. Continuation training will be an ongoing event, not just an annual exercise six months after qualification. With the influx of new personnel, the commander may deem it necessary to conduct crew qualification in conjunction with continuation training. Depending on the availability of resources, the commander may conduct this training many times

per year. Although the commander has flexibility in determining the level of his unit's continuation training program, it is recommended that team be the minimum level maintained.

d. In developing the unit's aerial gunnery training program, commanders are encouraged to "battle list" crews in attack and scout aircraft. This will train them as "fixed" crews to the maximum extent possible. Crew designation and stabilization, when feasible, greatly improve the unit's fighting power. They also provide the opportunity to train as we will fight.

1-4. GUNNERY TABLES

a. The gunnery tables in Chapter 4 provide the commander an evaluation tool in exercising all weapon systems in various modes. These tables represent numerous hard and soft targets found on most current ranges. Commanders have the flexibility to vary target arrays based on local range facilities.

b. Commander's tables give the commander flexibility in developing his training program. These tables can be used for prequalification training and the commander's evaluation or in exceptional circumstances. They can also be used to evaluate UTs for front-seat duties or refresher training for qualified aviators arriving from nonflying duties.

c. Units will qualify on the crew tables annually. Continuation training on crew tables may be conducted at the discretion of the commander.

d. Team tables allow the commander to exercise teams using various target arrays. Commanders must ensure that complete fire distribution is achieved on the array. This is accomplished through battle drills, team coordination, and realistic TSOPs. Commanders may designate the size and composition of the team based on the

unit's mission. All target arrays depicted are for illustration purposes only. Actual target arrays will be based on local range facilities and the unit's mission. Cavalry and attack mission differences may require different arrays.

e. Combined arms/JAAT tables allow the commander to deploy his forces as a member of a combined arms exercise. Commanders may select the size of the element to conduct these tables; however, it is recommended that a team be the lowest level.

1-5. CONTINUATION TRAINING

Continuation training should be an integral part of the commander's aerial gunnery program. The commander should view this training as continuation training of new attack pilots and experienced pilots. Conduct continuation training as frequently as facilities allow. Commanders who conduct firing events every six months cannot expect to maintain a combat-ready unit.

a. In continuation training, the commander should make maximum use of simulators and simulation devices. With decreased resourcing of TOW and Hellfire missiles, the flight weapons simulator or combat mission simulator provides commanders a viable alternative to firing live missiles. Maximum firing of these systems in simulators should be stressed at all levels of command.

b. In addition to continuation training of crews, commanders must evaluate the continuation requirements of their unit. Training must be continuous to maintain required standards. Taking into consideration the turnover of personnel, resource availability, and proficiency levels of assigned personnel, commanders should strive to maintain the unit at a designated level of proficiency.

BALLISTICS

Ballistics is the science that deals with the motion of projectiles and the conditions that affect that motion. The types of ballistics are interior, exterior, aerial, and terminal. Each produces dispersion—the degree projectiles vary in both range and deflection about a target. To place effective fires on targets, aircrews must first understand ballistics.

2-1. INTERIOR BALLISTICS

Interior ballistics deals with those characteristics that affect projectile motion within the barrel, tube, or internal rocket motor combustion. These characteristics affect the accuracy of all aerial-fired weapons and cannot be compensated for by aircrews when they fire free-flight projectiles. These characteristics are discussed below.

a. Barrel Wear. Gaseous motion, residue deposits generated by burning propellant charges, and projectile motion may wear away the barrel's inner surface or cause deposits to build up. Any of these conditions result in a loss of muzzle velocity and may induce excessive yaw.

b. Propellant Charges. Although propellant charges for aerial weapons are fixed, production variation can cause small differences in muzzle velocity and trajectory. In addition, temperature and moisture in the storage environment affect propellant burning. However, these variations normally do not significantly influence flight trajectory.

c. Projectile Weight. Projectiles of the same caliber, particularly linked-ball and tracer ammunition, may vary slightly in weight. The heavier projectile, with all other factors the same, will have a lower velocity.

d. Launcher Tube Alignment. Rocket launchers, except M260 and M261 lightweight rocket launchers, consist of individual tubes that can be replaced when they fail. Tubes are aligned by the internal or end bulkhead; however, the precise alignment of each tube may vary, particularly after launcher repair. Because of variances in alignment, the launcher boresight also varies from tube to tube. Proper boresighting of the launcher should include checking the boresight of several tubes and selecting the one that best represents the launcher.

e. Thrust Misalignment. A perfectly aligned free-flight rocket is one in which control of thrust would pass directly through the CG of the rocket. Since all manufacturing processes are imperfect, an end product is produced within a certain tolerance. Therefore, free-flight rockets have an inherent misalignment. Thrust misalignment is the greatest cause of error in free flight. Spin during the burn phase reduces the effect of thrust misalignment. Since a rocket is aerodynamically stabilized, firing it at a forward airspeed of 40 knots or more provides a favorable relative wind, which also counteracts thrust misalignment. When the rocket is fired from a hover, the favorable relative wind is replaced by an unfavorable and turbulent wind—rotor downwash. This results in a maximum thrust misalignment and a large dispersion of rockets.

2-2. EXTERIOR BALLISTICS

Exterior ballistics deals with those characteristics that affect the motion of the projectile as it moves along the trajectory. The trajectory is the path described by the CG of the projectile as it passes from the muzzle of the weapon to the point of impact. Aerial-fired weapons have all the exterior ballistic characteristics associated with short-range, ground-fired weapons as well as other characteristics unique to helicopters. Exterior ballistics that affect all weapon systems are described below.

a. Air Resistance, Drag. Drag is caused by friction between the air and the projectile. It is proportional to both the cross-sectional area of the projectile and its velocity.

b. Gravity. The loss of altitude as a function of gravity is directly related to range. As range increases, the amount of drop caused by gravity becomes greater. This drop is proportional to time of flight (distance) and the muzzle velocity of the projectile. Gravity drop is compensated for by

harmonizing turret weapons and using the mil settings on the sight card for the 2.75-inch FFAR. However, sight card mil settings do not apply to AH-1S(MC) and AH-64 aircraft. To hit the target, door gunners must correct gravity drop themselves. Table 2-1 shows corrections for gravity drop for different rounds.

c. Yaw. Yaw is the angle between the centerline of the projectile and the trajectory. Yaw causes the trajectory to change and increases drag. The direction of the angle of yaw constantly changes in a spinning projectile. Yaw is at maximum near the muzzle. It gradually subsides as the projectile stabilizes.

d. Projectile Drift. US projectiles, as viewed from the rear, spin in a clockwise direction. A spinning projectile acts as a gyroscope and exhibits gyroscopic precession. This force causes the projectile to precess, or move, to the right (horizontal plane gyroscopic effect). To compensate for this effect in all aircraft (except the AH-64), the gunner must aim to the left of the target. As the range increases, projectile drift increases; the gunner has to increase the correction for the projectile to hit the target. Gunners can compensate for projectile drift by establishing combat sight settings or adjusting rounds on target. The fire control computer on the AH-1S(MC) and AH-64 compensates for projectile drift. Figure 2-1 shows projectile drift.

e. Wind Drift. The effect of wind on a projectile during flight is called wind drift. The amount of drift depends on the projectile's time of flight and the wind speed acting on the cross-sectional area of the projectile. Time of flight depends on the range to the target and the average velocity of the projectile. When firing into a crosswind, the gunner

must aim upwind so the wind can drift the projectile back to the target. Firing into the wind or downwind will require no compensation laterally but will require some adjustment in range.

2-3. AERIAL BALLISTICS

a. Common Characteristics. The characteristics peculiar to aerial-fired weapons are based on whether the projectiles are spin-stabilized or fin-stabilized and whether they are fired from the fixed mode or the flexible mode. All fixed weapon systems do, however, have the following characteristics:

(1) Rotor wash error. Rotor wash is a force that acts on the projectile as it leaves the launcher. This causes it to change trajectory. This condition occurs when the helicopter is operating below ETL. At higher airspeeds, the rotor system operates in clean air and the relative wind more heavily strikes the nose of the projectile.

(a) Although rotor wash affects the accuracy of all weapon systems, it most affects the 2.75-inch FFAR. Maximum error is induced by rotor wash when the weapon system is fired while the aircraft is hovering IGE as shown in Figure 2-2. During this condition, air flows downward through the rotor blades. This causes the rocket to pitch up as it leaves the launcher.

(b) When the rocket passes beyond the rotor disk, air flows upward and causes the rocket to wobble. This results in both lateral and linear errors.

(c) When the aircraft is hovering OGE as shown in Figure 2-2, the relative wind strikes the rocket only from above after the rocket leaves the

Table 2-1. Corrections for gravity drop

Round	Muzzle Velocity (Feet Per Second)	Range (Meters)	Gravity Drop Correction (Mils)
7.62-mm	2,750	1,000	7.05
20-mm	3,380	1,000	12.30
30-mm	2,200	1,000	33.40
40-mm	790	1,000	86.70

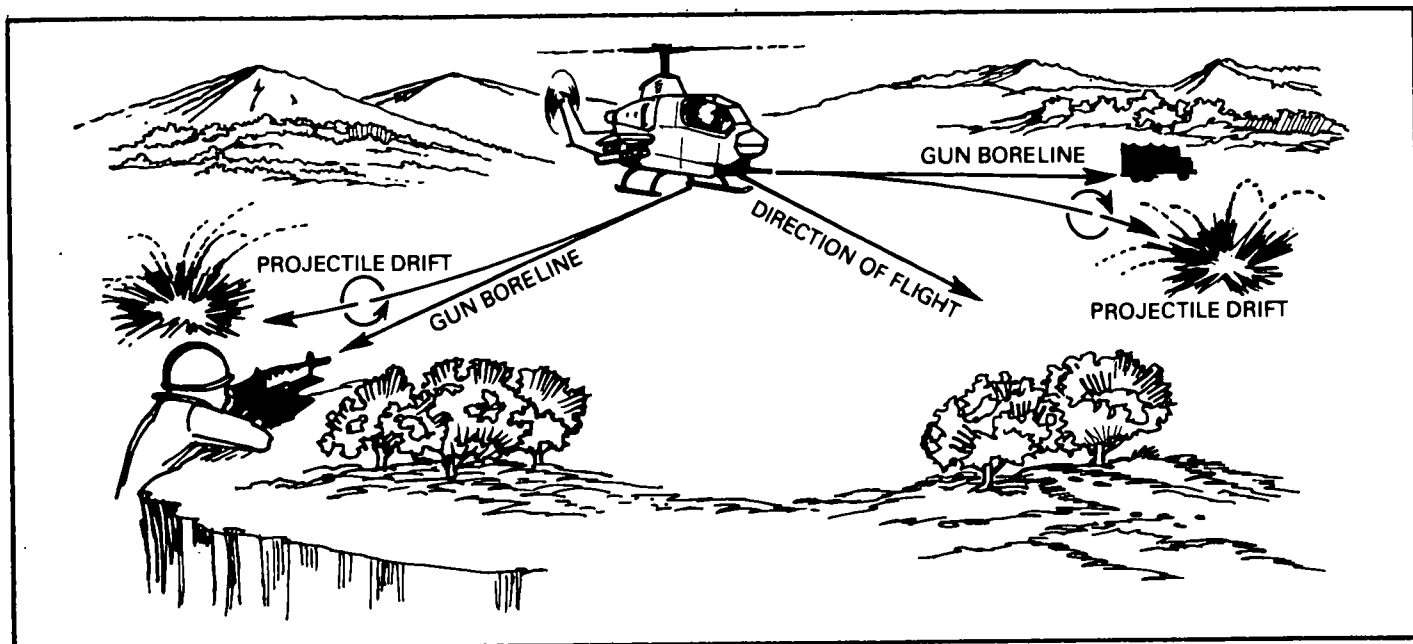


Figure 2-1. Projectile drift

launcher. This condition decreases the lateral error. However, velocity of the rotor wash will increase because of the additional power required to maintain a hover OGE. This, in turn, will increase linear dispersion.

(d) Linear dispersion is further increased in high-density altitudes and with heavily loaded aircraft. During both conditions of hover flight, the true airspeed vector of the helicopter will affect the position of rotor downwash and the downwash velocities at the respective launchers. For instance, holding a position over the ground during a right crosswind will result in a true airspeed vector to the right and a shift of the downwash to the left. This

shift causes the left rocket to be influenced for a longer time during launch than the right rocket. The left rocket also will pitch up to a higher QE and go further than the right rocket.

(e) To prevent a divergence of trajectories, the aircraft can drift with the wind, if terrain allows. This provides a more consistent rotor wash for both launchers.

(f) Detailed system testing has not shown that differences of QE are required for right versus left launchers during hover fire. However, it has shown that the true airspeed vector is important.

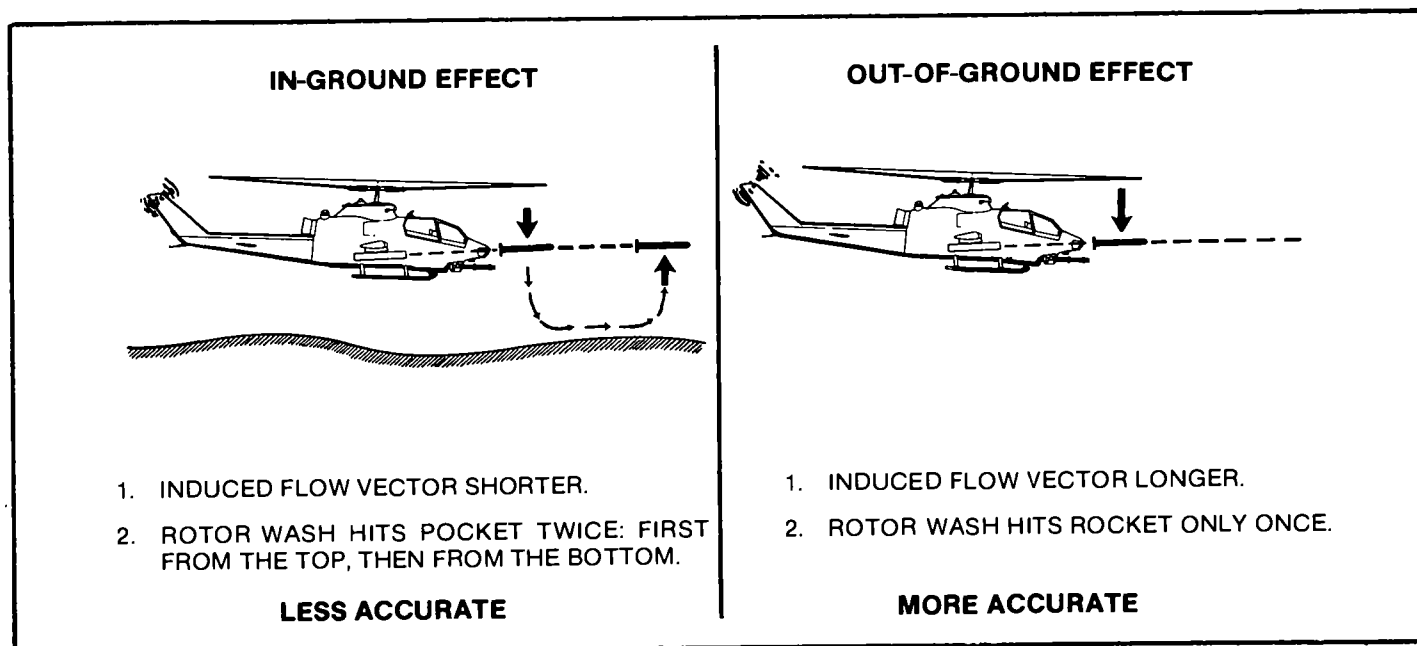


Figure 2-2. Rotor wash error

(2) Angular rate error. Angular rate error is caused by the motion of the helicopter as the projectile leaves the weapon. It affects most weapon systems and is lessened by firing from a hover using the pitch-up delivery technique.

(a) Angular rate error affects most weapon systems. The exceptions are the TOW, the SS-11 missile, and the Hellfire missile. For example, a pilot using the running-fire delivery technique to engage a target at 5,000 meters must pitch up the nose of the helicopter to place the gunsight reticle on the target. When the weapon is fired, an upward motion is imparted to the projectile by the movement of the helicopter. The amount of error induced depends on the distance to the target, the rate of motion, and the airspeed of the helicopter when the weapon is fired.

(b) Angular rate error occurs to a lesser degree when aircrews fire from a hover using the pitch-up delivery technique. Anytime a pitch-down motion is required to achieve the desired sight picture, the effect of angular rate error will cause the projectile to land short of the target.

b. Spin-Stabilized Projectiles. Certain aerial exterior ballistic characteristics are peculiar to spin-stabilized projectiles fired from weapons with rifled barrels such as the 7.62-, 20-, and 30-millimeter. When these projectiles are fired in the fixed mode (straight ahead of the helicopter), they generally have the same ballistic characteristics as ground-fired weapons. However, relative wind changes and the velocity of the helicopter increase or decrease the velocity of the projectile. The following ballistic characteristics affect spin-stabilized projectiles fired in the flexible mode.

(1) Trajectory shift. When the boreline axis of the weapon differs from the flight path of the helicopter, the forward velocity of the helicopter changes the direction and velocity of the projectile. For deflection shots within 90 degrees of either side of the helicopter heading, trajectory shift will cause the round to hit left or right of the target. To correct for trajectory shift, gunners should lead the target (place fire on the near side of the target as the helicopter approaches it). The amount of lead depends on the airspeed of the helicopter, angle of deflection, velocity of projectile, and range of the target. Compensation for trajectory shift is not required when projectiles are fired from a stationary hover. Figure 2-3 shows trajectory shift. Table 2-2 shows examples of compensation for trajectory shift.

(2) Port-starboard effect. Trajectory shift and projectile drift result in a port-starboard effect. When targets are on the left, the effects of drift and shift compound each other; both cause the round to move right. To hit the target, gunners must correct for both ballistic effects by firing to the left of the target. When targets are on the right, the effect of projectile drift (round moves right) tends to cancel the effect of trajectory shift (round moves left). Therefore, firing requires less compensation. The range and airspeed at which a target is engaged determine which effect is greater. For example, at close ranges (less than 1,000 meters), trajectory shift is greater. Gunners must fire to the right of the target. At longer ranges (beyond 1,000 meters), the effect of the projectile drift is greater and tends to cancel the effect of trajectory shift.

(3) Projectile jump (vertical plane gyroscopic effect). If a projectile is fired in any direction other than along the angle of relative wind to the muzzle, projectile jump will occur

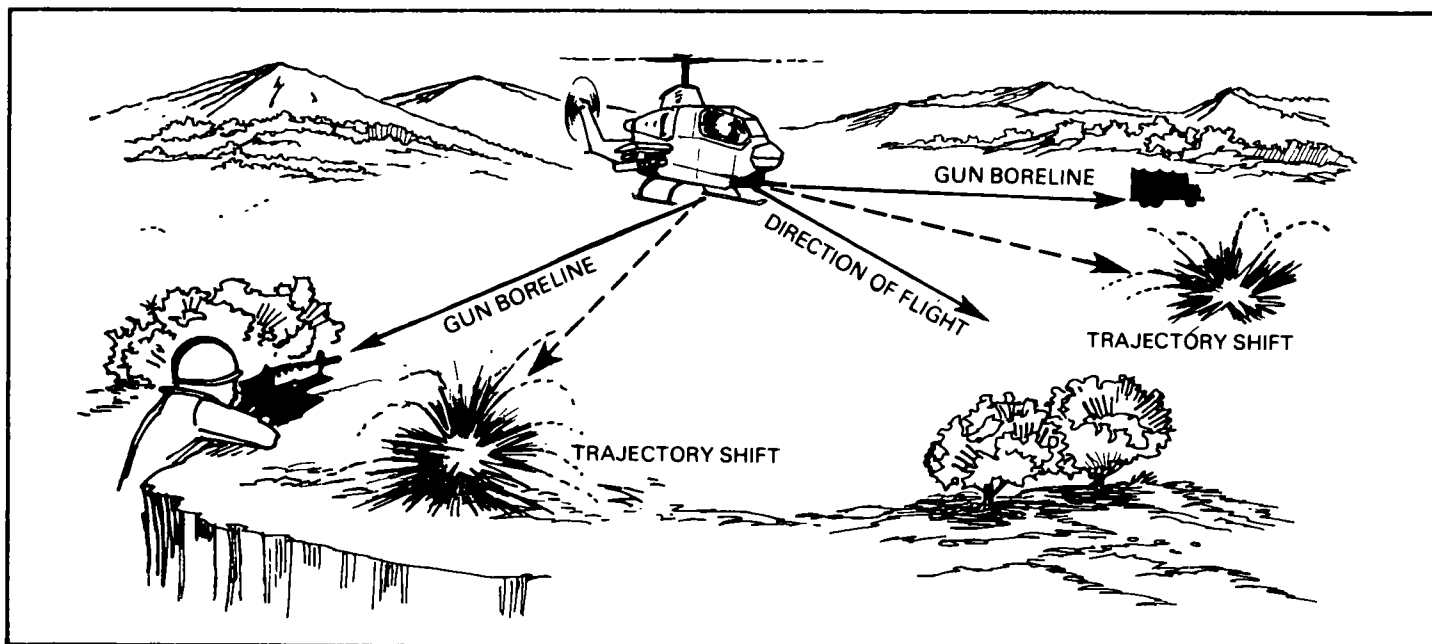


Figure 2-3. Trajectory shift

Table 2-2. Typical lead angles for a 60-degree deflection shot at 1,000 meters

Round (Millimeter)	Muzzle Velocity (Feet Per Second)	Helicopter Velocity (Knots)	Lead Angle (Mils)
7.62-mm	2,750	100	51
20-mm	3,380	100	47
30-mm	2,200	100	64
40-mm	790	100	182

NOTE: Attack helicopters are equipped with a system that automatically corrects for trajectory shift.

during running fire. This results from an initial yaw 90 degrees in the direction of rotation of the round because of the precession induced by crosswind. A projectile elevation jump is proportional to initial yaw. Firing to the right produces a downward jump; firing to the left produces an upward jump. Since compensation devices do not correct for projectile jump, gunners must aim slightly above a target on the right of a helicopter and slightly below a target on the left. The amount of compensation required, in the opposite direction from the jump, increases as helicopter velocity and angular deflection of the weapon increase. Compensation for projectile jump is not required when projectiles are fired from a hover.

c. Fin-Stabilized Projectiles. The exterior ballistic characteristics affecting fin-stabilized projectiles are of major importance. They are described below.

(1) Propellant force. The maximum velocity of a bullet is at or near the muzzle; however, a rocket continues to accelerate until motor burnout occurs, approximately 1.5 seconds after launch. As the rocket reaches its greatest velocity, the kinetic energy in the rocket tends to overcome other forces and causes the rocket to travel in a flatter trajectory. The motor of the TOW, SS-11 missile, or Hell-fire missile will continue to function forward of the aircraft.

NOTE: To equalize thrust from exhaust nozzles, fin-stabilized rockets rotate approximately 15 revolutions per second.

(2) Center of gravity. Unlike a bullet, the CG of a rocket is in front of the center of pressure. As the rocket propellant burns, the CG moves farther forward. The fins cause the center of pressure to follow the CG.

(3) Relative wind effect. When the helicopter is flown out of trim either horizontally or vertically, or both, a greater crosswind component acts on the surface of the rocket as it leaves the launcher. Because the velocity of the rocket is slowest as it leaves the launcher, the force acting upon the fins will cause the nose to turn into the wind.

(a) A horizontal out-of-trim condition results from the pilot's trying to align the gunsight on the target during a crosswind condition by cross-controlling, or slipping, the helicopter. For example, assume a helicopter is flying at 100 knots while the pilot maintains 10 degrees out of trim with a quartering crosswind component of 10 knots. This will cause the rocket to turn about 4 degrees into the relative wind after leaving the tube. As the velocity of the rocket increases, this turning effect will decrease. If the pilot is unable to align the helicopter into the wind, the gunsight must be corrected upwind. While firing from a hover or during slow flight, the pilot must make a downwind correction because the rocket will turn into the wind.

(b) A vertical out-of-trim condition results from an improper power setting. This creates a vertical relative wind on the rocket during launch. The rocket will turn into the wind. The diversion will be greater than the subsequent wind drift after motor burnout. If the pilot fires the rocket while

applying power (as in a climb), the relative wind will be from above. This will cause the rocket to hit beyond the target. To maintain a vertical trim condition, the pilot must adjust to a power setting that will maintain a desired airspeed and altitude.

(c) Both horizontal and vertical out-of-trim conditions can exist when the helicopter is firing in a crosswind while at a hover. The rotor wash produces a downward relative wind. The crosswind induces a horizontal relative wind. The effect of the resulting relative wind component on the rocket causes it to turn in the direction of the surface wind. Trajectory error caused by the relative wind cannot be accurately compensated for during the initial firing.

(4) **Real wind effect.** When the rocket is fired from a hover, a crosswind will cause it to initially turn into the real wind, since the rocket will sense this wind as a relative wind. Figure 2-4 shows the real wind effect. At rocket motor burnout, the rocket becomes a free-flight object and will drift with the air mass (real wind). As a rule, if the crosswind component is approximately 10 knots from the right, the rocket will turn right into the real wind. If the target is at 3,000 meters, the rocket will drift back to the left to hit near the target. With the same line of sight at ranges less than 3,000 meters, the rocket will impact to the right of the aiming point. At ranges beyond 3,000 meters, the rocket will impact to the left of the aiming point. This effect varies significantly as the crosswind component increases. To prevent this, aircrews should select firing positions that allow them to fire with a tail wind or head wind if possible. An aircrew can also compensate for this effect by allowing the helicopter to drift with the real wind; however, the aircrew will have to aim upwind to compensate for real wind drift, except for the AH-1S(MC) and the AH-64.

2-4. TERMINAL BALLISTICS

Terminal ballistics concerns those characteristics that influence the projectile at the target. Projectile functioning, including blast, heat, and fragmentation, is influenced by the following:

a. Impact Fuzes. Impact fuzes achieve surface and subsurface bursts of the warhead. The type of target being engaged and its protective cover will determine the best fuze to use. Targets in the open—such as personnel, vehicles, or logistical complexes—should be engaged with a superquick fuze that will cause the warhead to detonate upon contact. Targets with overhead protection, such as fortified positions or heavy vegetation, should be engaged with either a delay or forest penetration fuze. As shown in Figure 2-5, these types of fuzes will detonate the warhead after it penetrates the protective cover.

b. Proximity or Variable Fuzes. Timed fuzes produce airbursts and are most effective against targets with no overhead protection. The flechette, smoke, and illumination warheads incorporate a time fuze based on motor burnout. The range for this type of fuze is fixed. Electrically remote range-set fuzes have been developed for explosive, multipurpose submunition, smoke screen, illumination, and chaff warheads. The range is variable for this type of fuze and can be set from within the AH-1S(MC) and AH-64.

c. Surface Conditions. The surface of the target area—sand, rock, or vegetation—will affect the lethality of the projectile. If superquick fuzes are used against targets covered by heavy foliage, they will function high in the tree canopy and be ineffective at ground level. However, the same fuze would be effective against a target area with a sandy surface. Maximum effectiveness from the

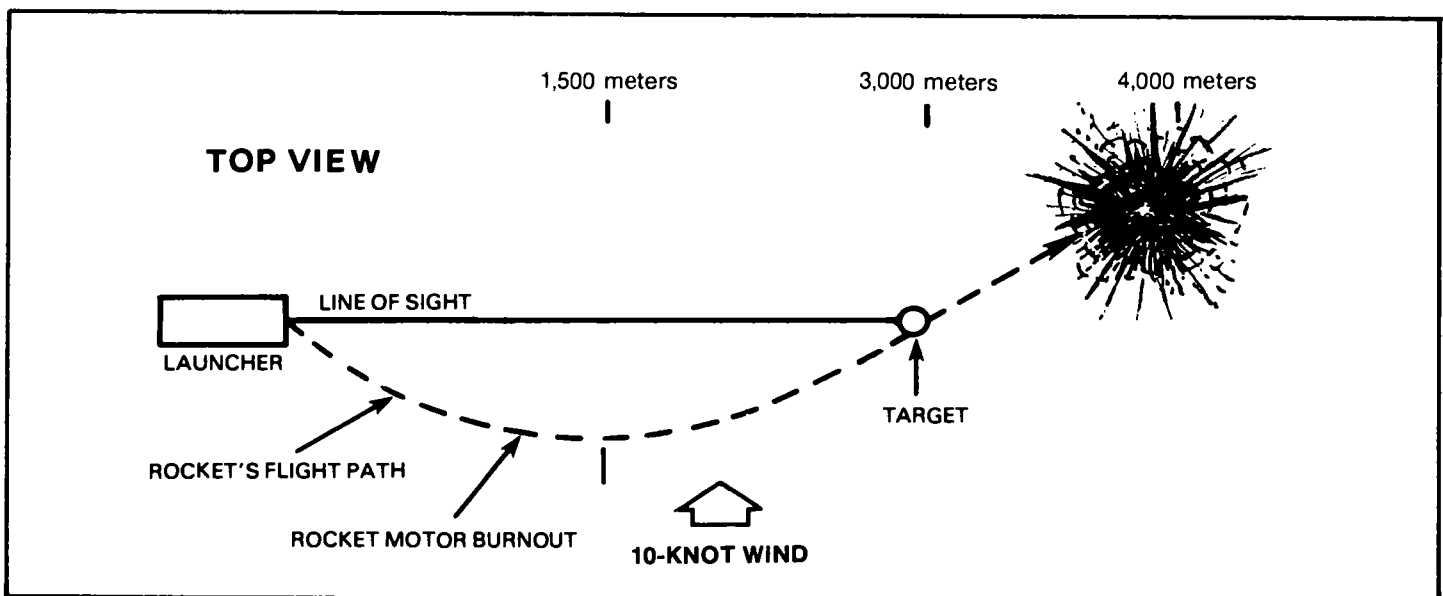


Figure 2-4. Real wind effect

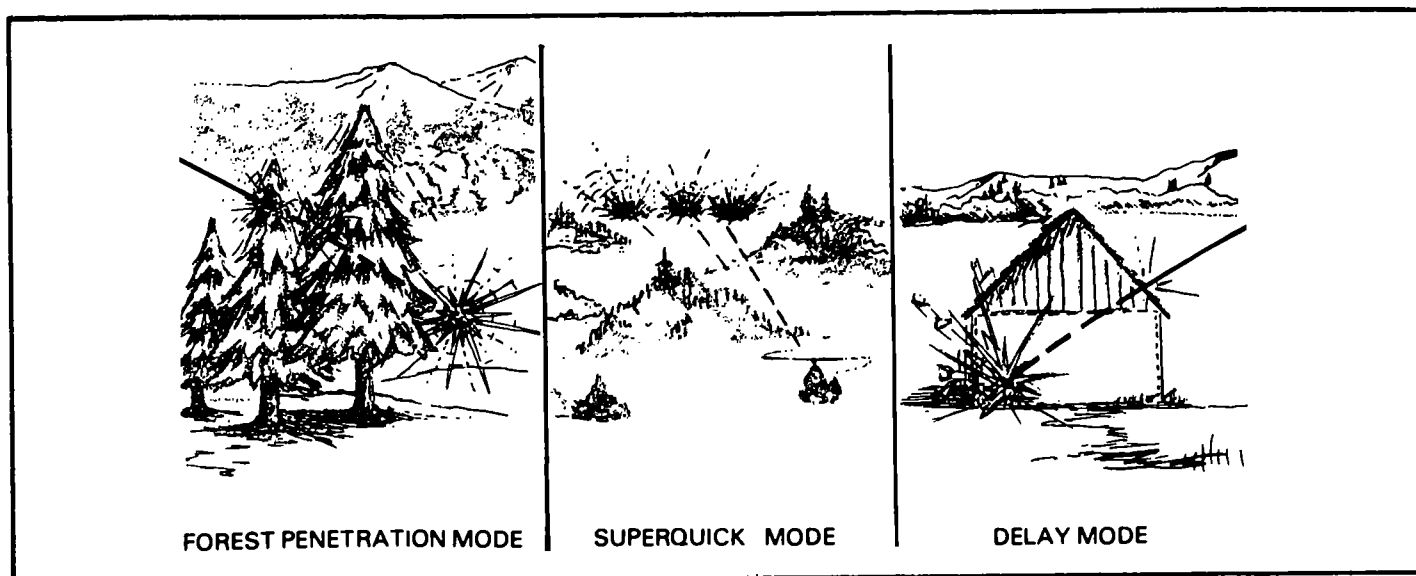


Figure 2-5. M433 multipurpose fuze/2.75-inch FFAR, high-explosive warhead

warhead requires that the proper fuze be used for the type of surface condition.

d. Warheads. The type of target to be engaged will determine which warhead to use. The HE warhead is the best all-purpose round. It can be armed with an impact fuze, quick or delay, and is effective against targets with or without overhead protection. Armor targets and heavy fortifications are best engaged with the high-explosive, dual-purpose round. Special-purpose and multipurpose submunition warheads provide for greater anti-personnel, antimateriel, and antiarmor destruction.

e. Angle of Impact. The altitude from which the projectile is fired and the range to the target determine the angle of impact and fragmentation pattern. Weapons fired with a high angle of impact produce fragmentation patterns that are close together. A projectile fired from NOE altitudes at the midrange of the weapon will form an elongated pattern with the projectile impacting at shallow angles. As the range increases, the impact angle of the projectile increases. The length of the fragmentation pattern decreases while the width increases. Figure 2-6 shows the angle of impact.

2-5. DISPERSION

If several projectiles are fired from the same weapon with the same settings in elevation and deflection, their points of impact will be scattered about the mean point of impact of the group of rounds. The degree of scatter of these rounds in range and deflection is called dispersion. The mean point of impact with respect to the target center, or intended air point, is an indication of the weapon's accuracy. Both dispersion and accuracy will determine whether a particular weapon can hit an intended target. Firing the 2.75-inch FFAR at maximum ranges decreases range dispersion and increases accuracy. The reverse is true with other weapon systems; that is, as range increases, dispersion increases and accuracy decreases. Dispersion is caused by errors inherent in firing projectiles. These errors are influenced, in part, by the following:

a. Interior Ballistics. Muzzle velocity is affected by minor variations in the weight, moisture content, and temperature of the propellant charge; variations in the arrangement and content of powder grains; and differences in the

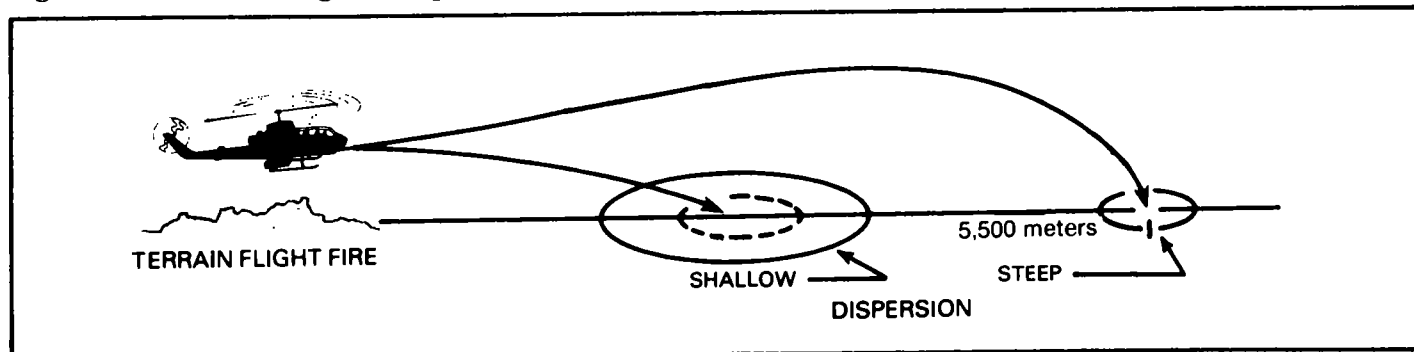


Figure 2-6. Angle of Impact

ignition of the charge. It also is affected by differences in the weight of the projectiles, variations in the temperature of the bore or tube, and wear on the bore or tube.

b. Vibrations in the Mount. Since the mount is fixed to the helicopter, vibrations in the helicopter are transmitted through the mount. These vibrations affect both deflection and elevation.

c. Gunsights. The condition of the gunsights and the accuracy of their alignment with the bore axes of the weapons will cause a displacement of the dispersion pattern of the projectiles. Therefore, aircrews must protect the gunsights and accurately harmonize weapons and establish combat sights.

d. Exterior Ballistics. From round to round, air resistance (drag) is affected by various factors. These include differences in weight of the warhead and of the propellant; velocity; the type of projectile; and changes in wind, air density, and temperature.

e. Terminal Ballistics. Targets engaged at close ranges from terrain flight altitudes have a low angle of impact. This causes large dispersion patterns. Dispersion patterns are also a function of airspeed for aerodynamically fin-stabilized rockets.

NOTE: Aircrews must compensate for external ballistics and use good delivery techniques to fire projectiles from a helicopter accurately. Frequent training of aircrews in helicopter gunnery techniques will improve accuracy.

DELIVERY TECHNIQUES

Weapon systems on attack helicopters are only as effective as the aircrews (pilot and gunner) who operate them. To place immediate effective fire on targets, aircrews must accurately determine ranges to targets and use proper sighting techniques and tracking procedures. They also must be aware of special considerations for nonstandard conditions. Terrain flight firing enables aircrews to deliver effective fire and reduces aircrew vulnerability. Terrain flight techniques apply to both direct and indirect fire and can be accomplished by running or hover modes of fire. To achieve maximum target destruction, aircrews must be able to adjust rounds rapidly.

Section I

SIGHTING TECHNIQUES AND CONSIDERATIONS

3-1. BORESIGHTING

Armament personnel, with assistance from aircrews, must adjust each weapon subsystem and the gunsights to ensure the aiming point and impact point of the projectile are the same. Boresighting is the first step in this process. It involves adjusting the boreline axis of the weapon and the optical axis of the sight so that they are parallel to each other or converge at a distant point. Boresighting does not compensate for deviations caused by the ballistic characteristics discussed in Chapter 2. Normally, armament personnel are responsible for boresighting. However, aircrews should be required to supervise the boresighting of weapon systems. After rocket launchers are boresighted, the QE should be recorded in the aircraft logbook. The publications in the reference section describe boresighting procedures for specific helicopters and weapon subsystems.

3-2. PREFLIGHT CONSIDERATIONS

Aircrews and armament personnel must work together to ensure weapon systems are reliable and accurate. They should inspect gunsights during preflight and correct any deficiencies before performing the mission. When helicopters are armed with stowed weapons, the aircrews must know the QEs and ballistic corrections for the rocket launchers or gun pods.

3-3. SPECIAL CONSIDERATIONS

a. Units of Measurement. To ensure a projectile will impact at the desired point, aircrews must know certain information. They must know the direction, horizontal (or slant) range, speed of the helicopter, and sight setting. The degree (17.8 mils) is the most commonly used unit of angular measurement for target handover. At 1,000 meters, an angular deflection of one degree results in a deflection distance error of 20 meters. For each 1,000 meters of range, an additional 20 meters of shift will occur. For elevation or depression corrections, mils are normally used because of the mils correction capability of the M73 and M60 reflex sight. As a rule of thumb, 5 mils of elevation or depression will move the strike of the round about 100 meters.

b. Turning Error. Firing stowed and flexible weapons while the aircraft is in a bank changes what is normally deflection to elevation. This results in rounds impacting short of the target and inside the turn. To compensate for aircraft turning errors, aircrews must aim high and opposite the direction of the bank.

c. Range. Inaccurate range estimation results in rounds missing the target and reduces the element of surprise by alerting the enemy to an impending attack. Therefore, aircrews must train to estimate

the range accurately. The methods of determining range are discussed below.

(1) Visual range estimation. Estimation by eye is the most common method of determining range. While this method is the most rapid, it is the least accurate. Normally, visual estimation is more accurate when aircrews compare the range to known ranges. When estimating ranges visually, aircrews must consider the following:

(a) Nature of the target. A target that contrasts with its background appears closer. A target that either blends with its background or is partially hidden appears more distant.

(b) Nature of the terrain. Over smooth terrain, the pilot tends to underestimate range. Over rough terrain, the pilot tends to overestimate range.

(c) Visibility of the target. A target seen in full sunlight appears closer than one observed through haze or fog. When the sun is behind the target, the target appears more distant. When the sun is behind the observer, the target appears closer.

(2) Tracer burnout. Because a 7.62-millimeter round of tracer ammunition burns out at about 900 meters, aircrews can use the tracer burnout to estimate the range. For example, if the tracer ammunition burns out halfway to the target, the range to the target is double the tracer burnout range. Tracer burnout of the 20-millimeter is an unreliable source for estimating range. There is no tracer round for the 30-millimeter.

(3) Maps and photomaps. Before and during the mission, aircrews can use maps and photomaps to determine the ranges from prominent terrain features to the target. They can then compare actual ranges with ranges they have estimated visually. This procedure allows them to determine accurately the range to the target without unnecessarily exposing the aircraft to the enemy. The use of maps and photomaps at night, however, is restricted because terrain features can be identified at limited ranges.

(4) Electronic devices. Electronic devices provide the most accurate means of determining ranges to targets. Attack helicopters equipped with laser range finders provide aircrews fast and accurate range information, which improves first-round-hit capability.

(5) Sight mil values. Range can be determined by using the WRM formula:

$$R = \frac{W}{M} \times 1,000 \text{ meters.}$$

In this formula, R means range to target in meters. W means known target width in meters, and M means the mil value of the target width. For example, a crew acquires a tank known to be 7 meters long (W) and determines the reticle width to be 5 mils (M). By substituting these numbers in the WRM formula, the range (R) is determined:

$$R = \frac{7 \text{ meters}}{5 \text{ mils}} \times 1,000 \text{ meters} = 1,400 \text{ meters.}$$

(6) Doppler. If aircrews can find the target's position on a map, they can then enter the target's coordinates into the Doppler and select that target's number in the FLY-TO window. After aircrews place the display switch to DISTANCE-BEARING-TIME, the accurate range and direction to the target will be displayed.

d. Target Direction. Direction is expressed as a measurement from a reference direction. A direction to a target or an attack heading can be expressed in degrees. When aircrews use degrees to express direction, they usually give the direction in 5-degree increments. Direction may also be given as a cardinal compass point such as north, east northeast, or south southeast. When locating targets, positions, and so forth, aircrews usually use the clock method to express headings. Target direction is measured clockwise from the nose of the aircraft. Direction is usually combined with range or a polar plot; for example, "Target heading, 080 degrees; range, 1,500 meters" or "ZSU at my 3 o'clock; range, 3,500 meters."

e. Attitude Changes. A change in airspeed or CG will change the flight attitude of the aircraft. Because the correct firing attitude remains the same, the amount of gunsight movement needed to acquire the firing position will change. When aircrews use the attitude indicator to establish the firing position, a change in the flight attitude will induce a range error. For a high degree of accuracy, a standard loading configuration should be maintained.

f. Time. Exposure and engagement time factors are important elements of aerial gunnery training. With an increase in the sophistication of Threat weapon systems, attack crews must realize their degree of vulnerability as they hover, unmasked, for great periods. Exposure and engagement times are defined in paragraph 4-10.

Section II

MODES AND TYPES OF FIRE

3-4. MODES OF FIRE

a. Direct Fire. Direct fire is used to engage targets that are visible to aircrews. It can be used when any weapon subsystem is fired. Direct fire engagements can be conducted with running, hover, or diving fire.

b. Indirect Fire. Indirect fire is used primarily to engage area targets. Even if a pilot can see a target initially, he may no longer see it once he raises the nose of the aircraft to place the FCR on the target. Therefore, he should engage the target in the indirect mode. If neither crew member can see the target, indirect fires can be adjusted from the attitude indicator or HSI readings. Indirect fire engagements can be conducted with either running or hover fire.

NOTE: On the AH-1S(MC), when only the copilot can see the target, indirect firing of the 2.75-inch FFAR is accomplished through the TSU. As the gunner views the target with the TSU, the pilot superimposes the fire control reticle with the boresight reference symbol.

3-5. TYPES OF FIRE

a. Running Fire. Aircrews deliver running fire at flight altitudes when the helicopter is above ETL. Both direct and indirect fires can be delivered during running fire. The forward airspeed adds stability to the helicopter. This increases the delivery accuracy of weapon systems.

b. Hover Fire. The aircrew delivers hover fire when the helicopter is below ETL. The helicopter may be stationary or moving, but movement is always below ETL. The aircrew normally delivers hover fire from an ambush position after the helicopter is unmasked. However, the aircrew may deliver indirect hover fire from an obscured position. The unmasked hover firing position should be maintained only for short periods. Following missile tracking or short bursts of automatic weapon fire, the aircrew remasks the

helicopter. Where terrain permits or when enemy actions dictate, the pilot should move the helicopter laterally between bursts of fire so it does not appear to the enemy twice from the same position. Because the helicopter is less stable at a hover, the accuracy of some weapon systems is reduced. Point-type weapons are the most effective for hover fire.

c. Diving Fire.

(1) The advent of sophisticated air defense weapons in the mid- to high-intensive threat environment has taught Army aviators to fly low to avoid being detected and engaged. However, in low-intensive conflicts or when it has been determined that surface-to-air missiles, enemy aircraft, or weather are not considered factors, diving fire may be used. The advantages of diving fire are—

- Less vulnerability to enemy small arms fire.
- Increased armament loads due to decreased power requirements.
- Increased accuracy due to less rotor wash.
- Smaller beaten zone.
- Increased target acquisition and tracking capabilities compared to hover fire.

(2) Pitch cone coupling and transient torque are “by-products” of diving fire and must be recognized by the pilot. Pilots must thoroughly understand rate of descent versus airspeed, rate of closure, and rate of descent versus power.

(3) High rates of descent (up to 4,800 feet/minute) coupled with high flight path speeds require the pilot to monitor closely both rate of closure and terrain features. Target fixation can lead to excessively low pull outs or aircraft mishaps. The pilot must plan the dive recovery in time to avoid abrupt recovery maneuvers. If an abrupt recovery is attempted at high airspeeds, “mushing” of the helicopter may occur. Some operator’s manuals explain aircraft characteristics during “mushing” and discuss proper recovery techniques.

UNIT GUNNERY TRAINING PROGRAM

Success of attack helicopter aircrews on the battlefield depends largely on the quality of training received in preparation for combat. For aircrews to meet the challenge of combat, training must reflect to a greater degree than ever before the environment that they can expect to encounter on the battlefield.

Section I

UNIT GUNNERY

4-1. UNIT GUNNERY TRAINING CONSIDERATIONS

a. Eliminating recurring unrealistic training practices is one of the best ways to enhance combat realism. Aviation safety is important, but it is not an excuse for conducting unrealistic training. However, training proficiency and aircraft safety must be totally integrated to enhance combat effectiveness in all environments where we must prepare to fight. Commanders must manage available resources carefully and make maximum use of new and innovative training techniques. Emphasis must be placed on annual qualification and continuation training. Gunnery training must begin with the development of crew skills and progressively build through the team or section level, with standards of performance set at each level. Based on the unit's mission, the commander should select the appropriate level of continuation training.

b. After an aerial gunnery training program has been established, the commander must supervise the training program to make sure it is implemented as planned and that it meets the needs of the crew, as well as those of the unit. The commander assesses the aerial gunnery training program to determine his unit's level of training. This assessment is a continuing process that includes the diagnosis of many factors, such as resources, time, and after-action reports from previous firings. The commander's evaluations may be formal or informal.

c. Night training (both aided and unaided) must be thoroughly planned and should encompass all aspects of night operation under minimal light conditions. All facets of the combat crewman's training (ground handling of aircraft, refueling procedures, reloading of ammunition, preflight procedures, and unscheduled maintenance) are

conducted with nontactical light. Therefore, it is unrealistic to train the crewman to fly at night under tactical lighting conditions.

d. The training to be given an individual flight crew member depends on the qualification table to be fired and on his proficiency. The amount of ammunition required to attain the desired level of proficiency varies from one crewman to another. Expenditure of ammunition beyond what is required to achieve the desired level of proficiency is discouraged.

4-2. THE COMMANDER'S ASSESSMENT

Formal evaluations are normally done by higher headquarters. With a little time and manpower, however, any commander can conduct an informal evaluation of his unit. Informal evaluations can be made in two ways. Usually, an informal evaluation is a mental analysis of a unit's aerial gunnery training capabilities, based on the commander's personal observations of training during ARTEP or field exercises. Informal evaluations can also be based on actual data, which has been recorded by the commander or compiled by his staff, using standards recommended in this manual.

a. A commander's aerial gunnery training program should target weaknesses perceived either in previous training or in his formal or informal evaluations. This training program should mix tactics, gunnery, doctrine, and maintenance. The training program should also discuss the characteristics of the aerial weapon systems as shown in Appendix A. It must be continuous, not just conducted immediately before range firing, so that the unit maintains a continuous state of readiness. A training program is only a guide. The commander must develop and use a program based on his unit's needs.

b. The success of aerial gunnery training depends on the imagination and initiative of the commander. Flexible, realistic aerial gunnery training is essential. Available training devices and simulators should be used as much as possible. Training devices are covered in Appendix B. These devices conserve resources, such as ammunition and fuel, and provide a means of maintaining training proficiency when at the home station and when range time is restricted. Although NBC equipment needs improvement, the commander should conduct training with available equipment to prepare the unit for employment on the air-land battlefield. Night training must also be considered. This area is covered in more detail later in this chapter. Training must correct unit weaknesses and meet standards specified by the commander.

c. During his assessment process, the commander outlines his gunnery training program. To implement his program successfully, the commander should construct detailed plans for—

- Pregunnery instruction.
- Basic gunnery instruction.
- Range firing.

d. An aerial gunnery training program requires careful planning. The three keys to a successful program are—

- Start early.
- Be thorough.
- Be flexible.

e. Pregunnery training makes aircrews proficient in the basics required for the unit to operate. It is a prerequisite to basic gunnery training. Pregunnery subjects are evaluated as part of the aerial gunnery skills tests. The subjects are—

- Mission planning.
- Aircraft handling and terrain flight procedures.
- Map reading and navigation.
- NOE communication and target handover procedures.
- Target identification and range estimation.
- Crew coordination.
- Switch orientation.
- Aeroscout procedures.

NOTE: A separate skills test may be set up to evaluate the aeroscouts in the skills needed to accomplish the unit mission.

f. Basic gunnery training teaches the fundamentals of aerial gunnery. A written test covering these fundamentals should be given during the

AGST before going to the range. Basic gunnery subjects are—

- Aerial gunnery ballistics.
- Armament systems and ammunition.
- Firing techniques.
- Safety.
- Fire control.

NOTE: Fire control includes all the observations, calculations, and actions involved in firing a weapon, while minimizing the expenditure of ammunition.

4-3. NIGHT TRAINING

a. With sophisticated sighting and sensing equipment, modern armies can fight at night. A range of tactical possibilities will be opened up by new equipment. Even with new night vision devices, however, most weapons will still be less effective at night. The new equipment includes—

- Tank sights.
- NVG.
- ATGM sights.
- Thermal imagery devices.

b. With modern night vision equipment, it is possible to attack at night with more freedom of movement and fewer restrictions than in the past. However, night offensive operations still require more carefully designed control measures and preparation than day offensive operations. These include—

- Careful preparation during daylight hours to reduce confusion.
- Careful planning of primary and alternate means of communication.
- Careful planning and coordinating of suppressive fires to achieve superiority at the decisive place and time.
- Rapid concentration of forces at the selected place and time.

c. The fighting capability of present-day US aircraft in attack helicopter and air cavalry units is limited by reduced visibility. Inclement weather and darkness hinder flight and target acquisition. The unit's night-fighting capabilities increase significantly with the new AH-64 night vision systems. These systems include the TADS, the PNVIS, and the AH-1S FLIR package, which allow the unit to train to fight at night. The unit's night training program should include both aided night vision training (AN/PVS-5 night vision goggles) and unaided night vision training (naked eye). Information on unaided eye training is given in FM 1-204.

d. The AHIP has been implemented to develop a fully mission-capable helicopter. The AHIP is equipped with an MMS that contains a day TV, a thermal imaging system, and a laser designator/range finder. The AHIP will operate with attack helicopter, air reconnaissance, and FAO units to provide real-time combat information, reconnaissance, and security. The AHIP also provides aerial observation and target acquisition/designation in reduced visibility during day or night operations. With the Doppler navigation system, the aircraft and targets can be positioned and stored to eight-digit accuracy.

4-4. SAFETY CONSIDERATIONS

Safety must be an integral part of a unit's gunnery training program. Commanders evaluate unit mission, personnel proficiency levels, and required tasks to arrive at a training environment risk assessment. Once acceptable risks have been identified, courses of action must be defined. These courses of action must effectively manage the risks associated with achieving the level of gunnery the unit mission requires. Safety is a function of training, not a training inhibitor. Thorough, effective training produces safe pilots for both peacetime and wartime environments. Effective training also conserves assets. Although unfortunate, a combat loss in wartime is understandable. Accident losses in training are not understandable. Combat missions are a way of life in wartime. Training for combat missions in peacetime should also be a way of life.

4-5. PREGUNNERY CONSIDERATIONS

a. Preparation. The following is a list of preparatory fire activities that must be completed before the units arrive at the range:

- NOE qualification and aircraft currency.
- Crew and team tactical training.
- TOW and Hellfire tracking training.
- Tactical scenario and OPORD which maximizes realistic range firing conditions.
- Night and night vision goggle training.
- Boresighting and weapon system check.
- Crew positions tentatively designated.
- Aerial gunnery skills test.

NOTE: The tactical scenario will be compatible with the unit's TOE mission, with the expected area of operations, and with the general defense plan.

b. Aerial Gunnery Skills Test. The AGST helps the commander determine if his attack helicopter crewmen have the basic skills to begin firing exercises. Training and testing must begin far enough in advance of range training so that

remedial training and retesting can be conducted. The AGST evaluates individual proficiency and pregunnery training program effectiveness. The AGST can also serve as a diagnostic test during the commander's training evaluation. AGST must be conducted before all live firing. The AGST has several stations that crewmen must successfully complete before their actual range training and qualification. Those who fail to complete successfully any one task will need additional training and retesting. Suggested formats listing tasks are presented in Figures 4-1 and 4-2 and Figures 4-4 through 4-6. Other stations, including stations on aeroscout procedures, may be added to meet the needs and the mission of the specific unit. Suggested score sheet formats are included with each station.

c. Station 1—Mission Planning.

(1) The aviator will plan a mission (Figure 4-1) from an oral five-paragraph OPORD. This mission should be for a team-sized or section-sized element. It should be a viable mission for the type of unit to which he is assigned. The aviator will—

- Perform a thorough map reconnaissance.
- Plot known and suspected friendly and enemy positions.
- Select routes.
- Select holding and battle positions.
- Brief other pilots and crew members.

(2) This mission requires one officer, the scorer. Equipment requirements include a map, paper, an operation order, and a grease pencil and other writing implements.

d. Station 2—Terrain Flight Communication Procedures.

(1) In a simulated terrain flight environment, the aviator will demonstrate correct coordination. These procedures (Figure 4-2) will be evaluated under radio silence and under secure and unsecure radio transmission modes. The aviator will correctly use—

- Radio phraseology (Figure 4-3).
- ECM.
- CEOI.
- Internal target handover.
- Radio, SAM cards, hand-and-arm signals, or light signals to give or to recognize all elements of an external target handover.

(2) This mission requires one officer, the scorer. Equipment requirements include two ground radios, a 1/4-ton truck, and an OH-58 with APU or an AH-1 with APU. Other requirements include CEOI, unit SOP, and SAM cards.

MISSION PLANNING

NAME _____ GRADE _____

UNIT POSITION _____

TASK	GO	NO-GO	REMARKS*
1. Perform map reconnaissance.			
2. Plot suspected enemy locations.			
3. Preplan or plot indirect fire targets.			
4. Plot proposed FARP location.			
5. Plot known friendly positions.			
6. Select flight path.			
a. Checkpoints			
b. Rally points (contingency)			
7. Select proposed holding areas.			
8. Select proposed battle positions.			
9. Select possible escape and evasion routes.			
10. Select emergency extraction PZ.			
11. Brief other crew members.			
12. Recommend movement techniques.			

*Requires more training (9 of 12 tasks must be passed to receive a GO).

SCORED BY _____ DATE _____

GO _____ NO-GO _____

Figure 4-1. Mission planning (suggested format)

TERRAIN FLIGHT COMMUNICATIONS PROCEDURES SCORING

NAME _____ GRADE _____

UNIT POSITION _____

TASK NUMBER	GO	NO-GO	REMARKS*
1. Use recommended radio phraseology for: a. Attack order. b. External target handover. c. Internal target handover.			
2. Recognize communication electronic warfare.			
3. Use proper ECM procedures.			
4. Use abbreviated radio transmissions.			
5. Use SAM cards properly.			
6. Demonstrate proper use of CEOI.			

*Requires more training (five of six tasks must be passed to receive a GO)..

SCORED BY _____ DATE _____

GO _____ NO-GO _____

Figure 4-2. Terrain flight communications procedures scoring (suggested format)

	INTERNAL*		EXTERNAL
	PILOT TO GUNNER	GUNNER TO PILOT	AIRCRAFT COMMANDER TO PLATOON COMMANDER
Alert, Target Description	"ZSU"	"ZSU"	"K13A, this is K06A. Esti- mated tank company moving west. Two ZSUs to rear of company."
Target Location	"9 o'clock"	"12 o'clock"	"120 degrees, 2,800 meters, approaching crossroads at NM3914."
Execution	"Fire TOW/ firing rockets"	"Engaging"	
Method of Attack			"On my command" or "Attack at will."
Execution			"Unmask" or "Attack."
Postattack Action			"Move to holding area 4. Be prepared to attack from battle posi- tion 21."

*There is no specified format for an internal target handover. This is only a means for the crews to alert each other of a target. Format may differ between gunner alerting pilot and pilot alerting gunner. Each unit should establish a format in its SOP.

Figure 4-3. Suggested communications format

e. Station 3—Target Identification and Range Estimation.

(1) The aviator will identify both threat and friendly systems and accurately estimate the range to each. A suggested format for this is given in Figure 4-4. The ability to identify targets quickly as friend or foe can mean the difference between success and failure. The aviator will—

- Identify threat systems.
- Identify friendly systems.
- Know capabilities of threat systems.
- Calculate range estimation.

(2) This mission requires one officer, the scorer. This mission also requires threat system silhouettes.

TARGET IDENTIFICATION AND RANGE ESTIMATION SCORECARD			
NAME _____	GRADE _____		
UNIT POSITION _____			
TASK NUMBER	GO	NO-GO	REMARKS*
1. Identify _____ of _____ threat vehicles.			
2. Identify _____ of _____ friendly vehicles.			
3. Know capabilities and characteristics of _____ threat systems.			
4. Know vulnerable areas of _____ threat systems.			
5. Estimate range within <u>+300</u> meters of targets that are less than 1,500 meters away using unaided eye.			
6. Estimate distances at ranges greater than 1,500 meters with less than 25% error using unaided eye.			
7. Estimate distances at ranges greater than 1,500 meters with less than 15% error using aircraft sights or binoculars.			

*Requires more training (must identify at least 70 percent of vehicles to receive a GO; must correctly estimate 70 percent of ranges).

SCORED BY _____ DATE _____

GO _____ NO-GO _____

Figure 4-4. Target identification and range estimation scorecard (suggested format)

f. Station 4—Armament and Ammunition Handling.

(1) The suggested format for a scorecard for armament and ammunition handling is given in Figure 4-5. The aviator will—

- Perform a weapons preflight check.
- Perform an ammunition identification and inspection.

- Perform safing procedures.
- Perform loading and unloading procedures.
- Perform system malfunction and troubleshooting procedures on all weapon systems.
- Install turret weapon systems.

ARMAMENT AND AMMUNITION HANDLING SCORECARD			
NAME _____	GRADE _____		
UNIT POSITION _____			
TASK NUMBER	GO	NO-GO	REMARKS*
1. Identify and inspect ammunition. a. M134 linked ammunition versus M60 mg ammunition b. M129 ammunition versus M79 ammunition c. Inert 2.75-inch FFAR d. HE 2.75-inch FFAR e. 20-mm or 30-mm ammunition f. M257, illumination 2.75-inch FFAR g. TOW or Hellfire missile			
2. Install turret weapon systems.			
3. Check preflight weapon system using checklist.			
4. Employ safing procedures.			
5. Practice loading and unloading procedures.			
6. Display knowledge of malfunction and troubleshooting procedures.			

*Requires more training (must correctly complete five of six stations for a GO).

SCORED BY _____ DATE _____

GO _____ NO-GO _____

Figure 4-5. Armament and ammunition handling scorecard (suggested format)

(2) This mission requires one officer, the scorer. Equipment requirements for this mission include ammunition as required by specific aircraft and unit mission and one aircraft that is configured for a normal unit mission.

g. Station 5—Weight and Balance Computations.

(1) The aviator will complete DD Form 365F (Weight and Balance Clearance Form F) for different ammunition loading configurations. A sample incorrect DD Form 365F will be given to the crewman who checks it for correctness. The suggested format for a weight and balance computation scorecard is given in Figure 4-6. The aviator will—

- Acquire a working knowledge of AR 95-16 and weight and balance information contained in aircraft operator's manual and TM 55-405-9.
- Complete DD Form 365F, following applicable regulations.
- Review sample DD Form 365F for correctness.
- Review aircraft weight and balance records for correctness.

(2) This mission requires one officer, the scorer. Equipment requirements include a sample DD Form 365F, a DD Form 365C (Basic Weight and Balance Record), TM 55-405-9, and blank DD Forms 365F.

WEIGHT AND BALANCE COMPUTATION SCORECARD			
NAME _____		GRADE _____	
UNIT POSITION _____			
TASK NUMBER	GO	NO-GO	REMARKS*
1. Apply weight and balance regulations properly.			
2. Complete DD Form 365F properly.			
3. Identify errors in sample DD Form 365F.			
4. Identify errors in aircraft weight and balance records.			

 *Requires more training (must correctly complete three of four tasks).

SCORED BY _____ DATE _____

GO _____ NO-GO _____

Figure 4-6. Weight and balance computation scorecard (suggested format)

h. Station 6—Cockpit Emergency Procedures. The aviator must properly select and position the armament switches on all weapon subsystems to either arm or safe the systems. He will be able to perform the emergency procedures for all the armament subsystems and fully explain all procedures. The suggested format for cockpit emergency procedures is shown in Figure 4-7.

4-6. TOW/HELLFIRE QUALIFICATION ALTERNATIVES

a. TOW Qualification. Under STRAC, only one TOW will be allocated per airframe instead of one TOW per authorized crew member. To maintain currency, each crew member will accomplish at least one of the following annually: successfully fire a TOW from the aircraft at a moving target or successfully fire a TOW from the FWS.

(1) If the TOW malfunctions or misses the target through no fault of the gunner, then the crew member should be considered qualified as long as he correctly positioned the switches. The crew member should verify his proficiency with the weapon system in the simulator, if one is available.

(2) Although the FWS is a fully modernized Cobra cockpit, the TOW front-seat procedures are basically the same for all TOW Cobras. Therefore, a unit having fully modernized, ECAS, PROD, or MOD aircraft can use the FWS for front-seat TOW qualification. If the FWS is not available, the unit can have *crews* TOW-qualified up to 100 percent while only 50 percent of the *pilots* will be individually qualified firing a live TOW.

b. Hellfire Qualification. Under STRAC constraints, only one Hellfire missile will be issued per company per year. The other crew members of the unit will maintain Hellfire currency in the CMS and use the HTM only for shooting at a moving target. Commanders are encouraged to make maximum use of the CMS and HTM when developing the unit's gunnery training program. Such devices greatly improve the unit's proficiency level between live-fire exercises.

4-7. CARE AND HANDLING OF AMMUNITION

The training of support personnel in ammunition care and handling should be a continuous process at the unit level. All ammunition storage,

COCKPIT EMERGENCY PROCEDURES SCORECARD			
NAME _____		GRADE _____	
UNIT POSITION _____			
TASK NUMBER	GO	NO-GO	REMARKS*
1. Position all switches to arm all aircraft armament systems.			
2. Position all switches to safe all aircraft armament systems.			
3. Explain and perform the emergency procedures for all weapon subsystems malfunctions.			

*Requires more training (must pass three of three to receive a GO).

SCORED BY _____ DATE _____

GO _____ NO-GO _____

Figure 4-7. Cockpit emergency procedures scorecard (suggested format)

handling, and basic safety procedures should follow TMs 43-0001-27, 9-1300-206, 9-1340-222-20, 9-1400-461-20, and 9-1425-473-20; the unit SOP; and applicable Army regulations (ARs 385-62, 385-63, and 385-64). Ammunition characteristics are given in TM 9-1300-200.

4-8. ARTILLERY PROCEDURES

a. Integrating fire support into the battle plan is vital to the success of the aviation unit's mission.

To operate as a member of the combined arms team effectively, aviators must know the proper procedures in calling for and adjusting artillery.

b. The artillery call-for-fire is composed of six elements and are sent in three transmissions. Figure 4-8 describes the basic elements of the call-for-fire. Figure 4-9 shows a sample crew qualification scorecard (day). Figure 4-10 shows a sample crew qualification scorecard (night).

CALL-FOR-FIRE ELEMENTS

1. Identification: Artillery FDC and the observer's call signs from the CEOI. On the initial contact, complete call signs must be used. Thereafter, no call sign is necessary. However, an abbreviated call sign may be used; for example, M22 this is M81.
2. Warning Order:
 - a. "Adjust fire" is used when the observed does not have an accurate target location.
 - b. "Fire for effect" is used when the observed has an accurate target location.

XMSN Break: over
3. Target Location:
 - a. Grid normally has six place coordinates for AF and eight place coordinates for FFE. However, you may still use FFE with six place coordinates and give the name of a prominent terrain feature following the target description.
 - b. Before a location can be employed as a known point, it must be plotted in the FDC of the artillery unit providing the fire support. This is indicated by assigning either a name or number.
 - c. "Known point shift" is used when the geographic relationship between the known point and the target location can be described by using a reference line.

XMSN Break: over
4. Target Description:

What the target is.
How many elements within the target.
Activity of the target.
Degree of protection the target may have.
5. Method of Engagement:

Danger close
Trajectory
Ammunition
Distribution of fire (type sheaf)
6. Method of Fire and Control:

Btry/Plt R(L)
At my command
Time on target
Cannot observe

XMSN Break: over

Figure 4-8. Basic elements of the call-for-fire

CREW QUALIFICATION--DAY				DATE:				TIME:			
PILOT:				RANK:				SSN:			
GUNNER:				RANK:				SSN:			
UNIT:				ACFT TAIL NO:							
EVALUATOR:				RANK:				SSN:			

TASK	TARGET RANGE (METERS)	WPN MODE	FLT MODE	WPN SEQ RND	FIRING POINT	M O		RANGE (M) (ACTUAL)	TIME	HITS
						P	P		GOs AND NO-GOs	GOs AND NO-GOs
II-1	ARRAY 2,000-3,000	DIRECT	HOVER	2.75-in 5 RND						
	ARRAY 500-1,000	TSU	HOVER	20-mm 32 RND						
II-2	ARRAY 1,500-3,000	DIRECT	MOVING	2.75-in 5 RND						
	VEHICLES 500-2,000	HSS/ GUNNER	MOVING	20-mm 32 RND						
II-3	ARRAY 3,000-6,000	INDIRECT	HOVER	2.75-in 5 RND						
	20 TROOPS 500-1,000	HSS/ PILOT	HOVER	20-mm 32 RND						
II-4	ARRAY 3,000-6,000	INDIRECT	HOVER	2.75-in 5 RND						
	VEHICLES 1,000-2,000	TSU	HOVER	20-mm 32 RND						
II-5	ARRAY 2,000-6,000	INDIRECT/ DIRECT	HOVER	2.75-in 5 RND						
	VEHICLES 1,000-2,000	HSS/ PILOT	HOVER	20-mm 32 RND						
	TANK 2,500-3,500	TSU	HOVER	TOW 1 RND						
II-6	ENEMY AIR 500-2,000	HSS/ GUNNER	MOVING	20-mm 160 RND						
	ENEMY AIR 1,000-3,000	STADIA- METRIC	MOVING	2.75-in 5 RND						

REMARKS:

NUMBER GOs _____ NUMBER OF NO-GOs _____ OVERALL GOs AND NO-GOs _____

NOTE: Suggested format only--all conditions are variable at the commander's discretion.

Figure 4-9. Crew qualification scorecard--day (suggested format)

CREW QUALIFICATION--NIGHT

DATE:

TIME:

PILOT:

RANK:

SSN:

GUNNER:

RANK:

SSN:

UNIT:

ACFT TAIL NO:

EVALUATOR:

RANK:

SSN:

TASK	TARGET RANGE (METERS)	WPN MODE	FLT MODE	WPN SEQ RND	FIRING POINT	M		RANGE (M) (ACTUAL)	TIME	HITS
						P	P		GOs AND NO-GOs	GOs AND NO-GOs
II-7	ARRAY 2,000-3,000	DIRECT	HOVER	2.75-in 5 RND						
	VEHICLES 1,000-2,000	TSU	HOVER	20-mm 32 RND						
II-8	ARRAY 2,000-3,000	DIRECT	HOVER	2.75-in 5 RND						
	20 TROOPS 500-1,000	HSS/ GUNNER	HOVER	20-mm 32 RND						
II-9	ARRAY 2,000-4,000	INDIRECT	HOVER	2.75-in 5 RND						
	20 TROOPS 1,000-2,000	HSS/ PILOT	HOVER	20-mm 32 RND						
II-10	ARRAY 2,000-4,000	INDIRECT	HOVER	2.75-in 111 5 RND						
	VEHICLES 1,000-2,000	TSU	HOVER	20-mm 32 RND						

REMARKS:

NUMBER GOs _____ NUMBER OF NO-GOs _____ OVERALL GOs AND NO-GOs _____

NOTE: Suggested format only--all conditions are variable at the commander's discretion.

Figure 4-10. Crew qualification scorecard--night (suggested format)

4-9. JOINT AIR ATTACK TEAM

JAAT operations epitomize synchronization on the battlefield. There are usually three elements involved in JAAT operations. These elements are Air Force close air support aircraft (usually A-10s), Army attack helicopters, and field artillery. When these elements combine to attack enemy forces, the result is a synergistic effect which is greater than if each system were operating independently. For a detailed discussion of JAAT operations, refer to FM 1-111.

4-10. EXPLANATION OF GUNNERY TABLES

The gunnery tables are designed to allow commanders flexibility in conducting gunnery exercises. To allow for differences in range facilities and target array availability, a variety of arrays are shown at ranges from 500 to 6,000+ meters.

a. Use of Gunnery Tables.

(1) In developing a strategy for gunnery training, the commander should identify an array in the gunnery tables that best represents an available target array. Troop silhouettes can be fabricated locally and placed at various ranges, as shown in the tables.

(2) The range to the selected array must be identified. To allow for differences in range facilities, ranges in gunnery tables are flexible.

(3) The mode of flight and target condition may be selected based on the tactical scenario and the target array layout. When available, moving targets should be engaged. The commander should plan at least 50 percent of all his engagements at moving targets. On ranges that do not have moving targets, stationary targets in column or line formations should be used.

(4) The selection process as described in paragraphs (1), (2), and (3) above constitutes one engagement. Table 4-1 outlines the minimum number of successful engagements at various ranges required for qualification. For example, the commander selects target array 1 on Table 4-9. Local target array resembles this array. This array has a range of 3,000 meters and has targets in a stationary column. By selecting one item from each of the columns, commanders can custom-make their gunnery program and maximize gunnery training on ranges with limited facilities.

b. Target Effect.

(1) Target effect is a measurement of destroyed or disabled vehicles and personnel casualties. Target effect is expressed as a percentage of the target array affected. Disruption of enemy movement, force deployment, tactical con-

fusion, or target suppression to aid in escape is a function of target effect.

(2) The standard for target effect is determined by the following criteria (explained further in paragraph *c* below):

- Desired effect on target—suppression, neutralization, or destruction.
- Target area coverage as defined in Table 4-2.
- Maximum engagement time per target array.
- Maximum exposure time per engagement.
- Percent of successful engagements per table category as defined in Table 4-1.
- Percent of ammunition not expended.

c. Types of Tables. Distinctive tables, tailored to various unit missions, are provided for attack, cavalry, and light infantry (attack and cavalry) units. The categories in each table are commanders, crew, team (unit), and combined arms/JAAT. Each category is explained in paragraph 1-4.

(1) Attack helicopter unit tables stress using TOW and Hellfire against tank and assorted armored targets. Engagements may vary from 500 to 3,750 meters using TOW and out to 5,000+ meters using rockets in the indirect mode.

(2) Cavalry unit tables stress hipshoot gunnery at assorted lightly armored targets and dismounted infantry. TOW engagements are required but not highly stressed because of the cavalry's unique reconnaissance and security missions. The cavalry tables call for close-in engagements at targets of opportunity and indirect engagements at targets in excess of 5,000 meters.

(3) Light infantry division helicopter tables are designed for low- to mid-intensity conflict scenarios. These tables emphasize dismounted infantry, machine gun nests, MOUT, and so forth. Although some are furnished, hard targets are held to a minimum. The light infantry's mission is to fight in a low-intensity setting and retain utility in the mid- to high-intensity environment.

d. Simulation Tables. In addition to the tables listed above, simulation tables are provided to increase training on the aircraft's main gun. These tables show TOW and Hellfire engagements at various ranges and conditions (hovering or moving flight, stationary or moving target). TOW and Hellfire engagements can be conducted in the following manner:

- Live fire (realizing that resources will continue to be limited for these weapon systems).
- FWS and CMS, where available.
- MILES/AGES in a force-on-force scenario.

e. Scoring Criteria. As stated in paragraph **b** above, several factors must be considered when assessing target effect. An in-depth definition of each standard is shown below. A suggested scorer/evaluator training program is outlined in Appendix C.

(1) Suppression of a target limits the enemy's ability to engage or return fire in the target area. Firing high-explosive ammunition creates apprehension or surprise and causes tanks to button up. Also, dismounted infantry seeks cover, thereby reducing their combat effectiveness. The effect of suppressive fires usually lasts only as long as fires continue. Suppressive fire usually requires little ammunition to produce the desired effects. Table 4-2 gives both the target effect criteria for each weapon system and the target area coverage. Table 4-3 shows the maximum rounds to be expended per target during any engagement.

(2) Neutralization tasks take a target out of the battle temporarily. The unit again becomes effective when casualties are replaced and damage is repaired. A force is neutralized when ten percent of its equipment is damaged or ten percent of its personnel become casualties.

(3) Destruction occurs when the target is taken out of action permanently. Casualties or materiel damage of 30 percent or more normally renders a unit ineffective. Destruction missions usually require large amounts of ammunition.

(4) Maximum engagement and exposure times represent the satisfactory (GO/NO-GO) times. These are shown in Chart 4-1.

(a) Exposure time is computed from the time the helicopter unmask, the rounds impact on the target, and the helicopter remasks. It may be advantageous during direct rocket firing at long distances to remask after firing and unmask again.

It may also be advantageous to have another source give corrections and target effect.

(b) Engagement time is computed from target handoff in the battle position to the time that the desired target effect is achieved or contact is broken. Engagement time depends on target array, posture, and the number of aircraft in the team.

(5) Commanders at all levels should stress to their aircrews the importance of ammunition management. Conservation of ammunition resources during combat may well be the key to ultimate success. Ammunition shown in the gunnery tables reflects the maximum per target array. If crews satisfy target effect standards with less ammunition than shown, the remaining ammunition should be returned to the rear arm point. Under no circumstances should a crew who has successfully engaged a target array fire the remaining ammunition for practice or aviator proficiency. The commander may allot the remaining ammunition to aviators who failed to achieve the standards using the prescribed ammunition.

f. Modes of Fire and Modes of Flight.

(1) Modes of fire and modes of flight will be determined by the tactical scenario, by ammunition loading, and by weather conditions. Except when the situation (indirect fire or diving fire) dictates, the commander may determine the mode of flight. Firing weapon systems of the AH-1S(MC); AH-1S(ECAS); AH-1S(MOD) and AH-1S(PROD); AH-1G; UH-1B, UH-1C, and UH-1M; and AH-64 are found in Appendixes D, E, F, G, H, and I, respectively.

(2) Many tables require the crew to engage targets using two weapon systems simultaneously. Using the turret along with another system (TOW or 2.75-inch FFAR), most of these divergent shots require rapid suppressive fire on an unexpected enemy. This type of target array requires increased crew coordination and confidence in the weapon subsystems.

Table 4-1. Standards of engagement

<u>RANGE</u>	<u>ATTACK</u>	<u>CAV</u>	<u>LT INF (ATK)</u>	<u>LT INF (CAV)</u>
<1,999	2 of 3	4 of 5	2 of 3	4 of 5
2,000-2,999	5 of 6	4 of 5	5 of 6	4 of 5
3,000-3,999				
4,000-4,999				
>5,000	2 of 3	1 of 2	2 of 3	1 of 2

NOTE: Qualification is based on 9 successful engagements out of 12 for targets at various distances. A successful engagement is determined by comparing desired effect on target from gunnery tables with the target effect criteria in Table 4-2. For example, in an attack helicopter unit, two of three engagements must be successful at distances less than 1,999 meters, five of six from 2,000-4,999 meters, and two of three beyond 5,000 meters to satisfy qualification requirements.

Table 4-2. Scoring criteria

<u>AH-1/UH-1C/M WEAPON SYSTEM</u>	<u>RANGE(M)</u>	<u>TARGET EFFECT</u>
SS-11	500-2,900	Hit
TOW	500-3,750	Hit
20-mm	Up to 1,500	1/2 rounds in 50m x 100m target area
7.62-mm	Up to 1,500	2/3 of rounds in 100m x 200m target area
40-mm	Up to 900	2/3 of rounds in 100m x 200m target area
2.75-inch FFAR	1,000-1,999	1/2 of rounds in 300m x 700m target area
	2,000-2,999	1/2 of rounds in 300m x 600m target area
	3,000-3,999	1/2 of rounds in 300m x 500m target area
	4,000-4,900	1/2 of rounds in 300m x 400m target area
	5,000	1/2 of rounds in 300m x 300m target area
<u>AH-64 WEAPON SYSTEM</u>	<u>RANGE(M)</u>	<u>TARGET EFFECT (NONLASER/LASER)</u>
Hellfire	500-8,000	Hit
30-mm	IHADSS-Up to 1,999	2/3 rounds in 100m x 200m/NA
	IHADSS-2,000 to 3,000	2/3 rounds in 100m x 300m/NA
	TADS-500-1,499	2/3 rounds in 25m x 175m/25m x 125m
	TADS 1,500-2,499	2/3 rounds in 50m x 150m/50m x 100m
	TADS 2,500-3,000	2/3 rounds in 75m x 125m/75m x 75m
2.75-inch FFAR	IHADSS 1,000-1,999	1/2 rounds in 300m x 700m/NA
	IHADSS 2,000-2,999	1/2 rounds in 300m x 600m/NA
	IHADSS 3,000-3,999	1/2 rounds in 300m x 500m/NA
	IHADSS 4,000-5,000	1/2 rounds in 300m x 400m/NA
2.75-inch FFAR	TADS 2,000-2,999	1/2 rounds in 300m x 600m/300m x 500m
	TADS 3,000-4,999	1/2 rounds in 300m x 500m/300m x 400m
	TADS 5,000-6,999	1/2 rounds in 400m x 400m/300m x 300m
	TADS 7,000-9,000	1/2 rounds in 500m x 500m/400m x 400m

NOTE: AH-64 criteria for 2.75-inch FFAR based on estimation.

Table 4-3. Rounds per target

WEAPON SYSTEM	ROUNDS PER TARGET
7.62-mm	400
20-mm	32
30-mm	20
40-mm	20
2.75-inch FFAR	4
TOW	1
SS-11	1
Hellfire	1

g. STRAC Resources. STRAC provides a viable program for management of training ammunition. Commanders must understand how the STRAC program works and have a firm grasp of the unit's ammunition allocations.

h. Simulation Tables. Simulation tables stress crew coordination and simulated weapons firing. These tables also emphasize TOW engagements in various modes and ranges. Simulation tables may be conducted using the flight weapon simulator. The tables also may be conducted using the MILES/AGES in a force-on-force scenario or by using dry firing in a maneuver area. To fine-tune

crew skills and to ensure valuable range time is not wasted, simulation tables should be accomplished before team or combined arms/JAAT live-fire exercises.

i. Target Condition. The target conditions column of the gunnery tables (Tables 4-4 through 4-21) give commanders maximum flexibility when selecting target arrays available on local ranges. As shown in the gunnery tables, the threat array may be configured in numerous formations, either moving or stationary. Recommended distance between each target in the array is no less than 15 meters and no greater than 50 meters.

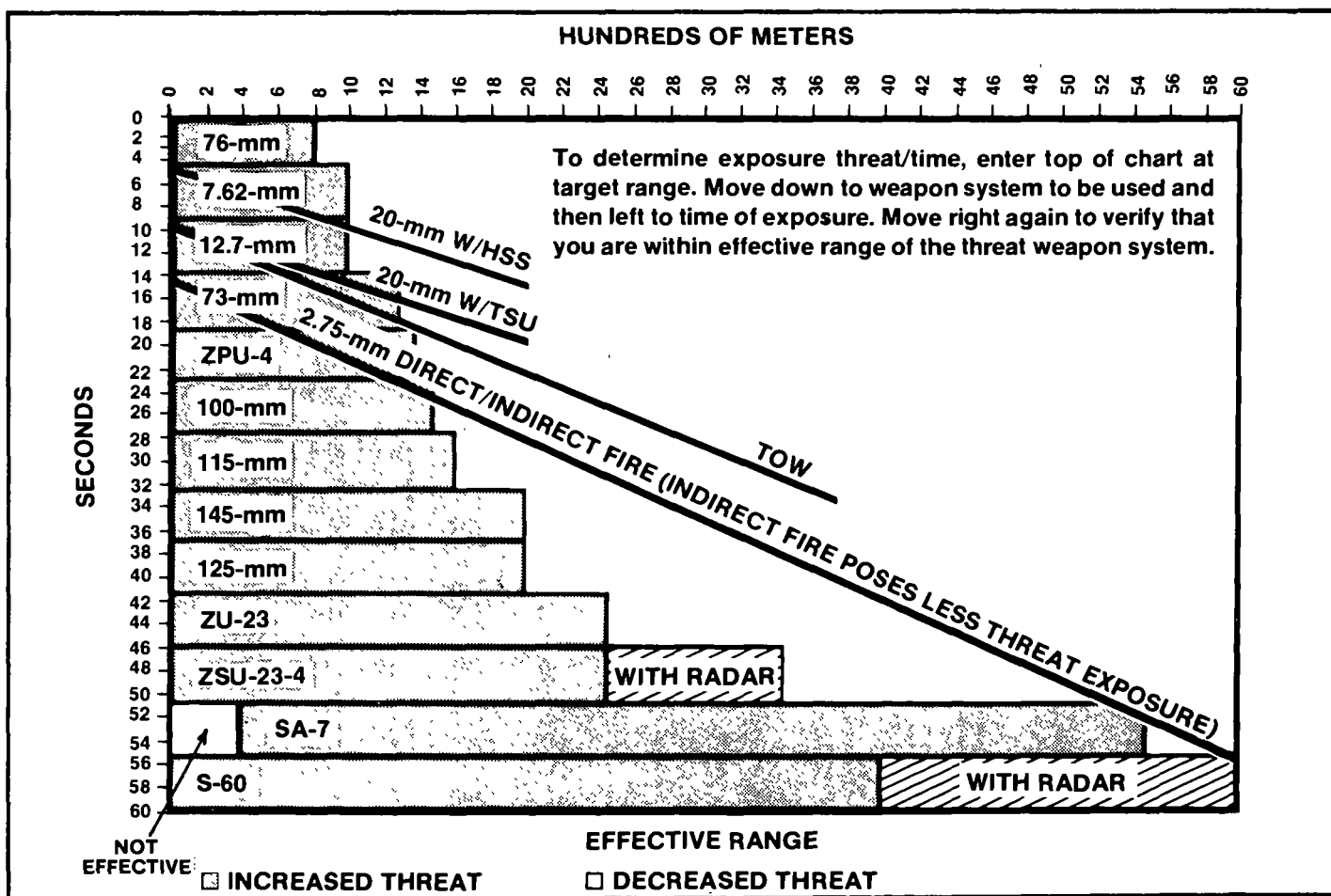


Chart 4-1. Exposure time

Table 4-4. AH-1/UH-1M commander's gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1/UH-1M Commander's Table (Gunner/Day)					
1 Tank	Up to 1,500	1 TOW (TSU)	Hover	Stationary	Destroyed
1 Lt Armored Veh	500-1,000	32 20-mm (TSU)	Hover/Moving	Stationary/Moving	Suppressed
Troops	750-1,500	32 20-mm (HSS)	Hover/Moving/Diving		Suppressed/ Neutralized
	750-2,000	20 40-mm (Fixed)			Neutralized
	1,000-3,000	20 40-mm (Flex)			
		400 7.62 (Flex)			
		400 7.62 (Fixed)			
		1 SS11			
AH-1/UH-1M Commander's Table (Gunner/Night)					
1 Lt Armored Veh	Up to 1,000	32 20-mm (TSU)	Hover/Moving/Diving	Stationary	Neutralized
Troops	Up to 1,200	20 40-mm (Fixed)		Stationary/Moving	Suppressed/ Neutralized
		20 40-mm (Flex)			Suppressed
		400 7.62 (Flex)			
		400 7.62 (Fixed)			
ALL TARGET COVERAGE SHOULD CONFORM TO TABLE 4-2.					

Table 4-4. AH-1/UH-1M commander's gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Commander's Table (Pilot/Day)					
1 Lt Armored Veh	500-1,000	4 2.75 (Direct)	Hover/Terrain Flight	Stationary	Neutralized
Troops	500-1,500	4 2.75 (Indirect)		Stationary/Moving	Suppressed/ Neutralized
	1,000-3,000	4 2.75 (Stadia- metric)			
	4,000-6,000	32 20-mm (HSS)			
		32 20-mm (Fixed)			
		400 7.62 (HSS)			
		400 7.62 (Fixed)			
AH-1 Commander's Table (Pilot/Night)					
1 Lt Armored Veh	500-1,000	4 2.75 (Direct)	Hover	Stationary	Suppressed
Troops	500-1,500	2 2.75 (Ill)	Hover/Terrain Flight	Stationary/Moving	Neutralized
	1,000-3,000	32 20-mm (Fixed)			
		32 20-mm (HHS)			
		400 7.62-mm (HSS)			
		400 7.62-mm (Fixed)			
ALL TARGET COVERAGE SHOULD CONFORM TO TABLE 4-2.					

Table 4-5. Attack helicopter battalion crew gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (1st Day)					
1 Tank	2,000-3,000	1 TOW/AGES	Terrain Flight/Diving	Moving Column	Neutralized; Cover- age of Target Area IAW Para 4-10e(2)
4 Assorted Veh		6 2.75	Hovering	Attacking Line	
10 Dismounted Troops		1,000 20-mm		Stationary Column or Stationary Assembled Unit	Total Engagement Time IAW Para 4-10e(4)(b)
		1,000 7.62			
		32 40-mm			Total Exposure Time Per Engagement IAW 4-10e(4)(a) and Chart 4-1
AH-1 Crew (2d Day)					
2 Assorted Armored Veh	500-1,500	1 TOW/AGES	Terrain Flight/Diving	Moving Column	Destroyed IAW Para 4-10e(3) and Table 4-2
	2,000-3,000	8 2.75	Hovering	Attacking Line	
4 Wheeled Veh	3,000-4,000	750 20-mm		Stationary Column or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2)
3 Dismounted Inf		1,000 7.62			
		32 40-mm		From a Forward or Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-5. Attack helicopter battalion crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (3d Day)					
1 Tank	500-1,500	1 TOW/AGES	Hover/Terrain Flight	Moving Column Attacking Line	Destroyed IAW Para 4-10e(3) and Table 4-2
2 Antiaircraft Sys	1,500-2,000	10 2.75		Stationary Column or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
4 Assorted Veh	2,000-3,000	1,000 20-mm		From a Forward Position	Total Engagement Time IAW Para 4-10e(4)(b)
10 Dismounted Inf	2,000-4,000	1,000 7.62			
	4,000-5,000	80 40-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
AH-1 Crew (4th Day)					
4 Lt Armored Veh	500-1,500	12 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Wheeled Veh	1,000-1,500	750 20-mm	Divergent Engagement		
10 Dismounted Inf	4,000-5,000	1,000 7.62		From a Forward or Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
3 Dismounted Inf	5,000-6,000	32 40-mm			
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-5. Attack helicopter battalion crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (5th Night)					
4 Assorted Wheeled Veh	2,000-3,000	8 2.75	Direct	Stationary Column or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
2 Towed Antiaircraft Sys		6 2.75 (111)	Hover/Terrain Flight/Diving		Total Engagement Time IAW Para 4-10e(4)(b)
10 Dismounted Troops		300 20-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
		1,000 7.62			
		32 40-mm			
AH-1 Crew (6th Night)					
2 Tanks	500-1,500	1 TOW/AGES	Hover/Terrain Flight/Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
4 Assorted Wheeled Veh	2,000-3,000	8 2.75			Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
20 Dismounted Troops	4,000-5,000	6 2.75 (111)			Total Engagement Time IAW Para 4-10e(4)(b)
10 Dismounted Inf		750 20-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
		1,000 7.62			
		32 40-mm			

Table 4-5. Attack helicopter battalion crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (7th Night)					
4 Wheeled Veh	500-1,500	8 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Lt Armored Veh	2,000-3,000	6 2.75 (111)	Divergent Engagement	From a Forward or Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
10 Dismounted Inf	3,000-4,000	750 20-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
3 Dismounted Inf	4,000-5,000	1,000 7.62 32 40-mm			Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-6. Attack helicopter battalion team gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (1st Day)					
4 Tanks	500-1,000	4 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Armored Veh	1,000-1,500	42 2.75			
2 Self-Propelled Antiaircraft Sys	1,500-3,000	3,750 20-mm		From a Forward Position	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
20 Dismounted Inf	2,000-4,000	5,000 7.62			
10 Dismounted Inf		300 40-mm			
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
AH-1 Team (2d Day)					
2 Antiaircraft Defense Sys	500-1,500	42 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
8 Assorted Lt Armored Veh	3,000-4,000	3,750 20-mm	Divergent Engagement		
3 Wheeled Veh	4,000-5,000	5,000 7.62		From a Forward or Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
30 Troops		300 40-mm			
10 Dismounted Inf					
2 Hand-held Anti-aircraft Sys					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-6. Attack helicopter battalion team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (3d Day)					
4 Tanks	1,000-2,000	4 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Lt Armored Veh	2,000-3,000	40 2.75			Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
3 Wheeled Veh		2,500 20-mm			
30 Troops		4,000 7.62			
		160 40-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Team (4th Day)					
4 Antiaircraft Sys	4,000-6,000	36 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
4 Assorted Lt Armored Veh					Total Engagement Time IAW Para 4-10e(4)(b)
3 Wheeled Veh					
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-6. Attack helicopter battalion team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (5th Night)					
4 Tanks	1,000-2,000	4 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Lt Armored Veh	2,000-3,000	40 2.75			
3 Wheeled Veh		12 2.75 (111)			
30 Troops		2,500 20-mm			
		4,000 7.62			
		160 40-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Team (6th Night)					
2 Antiaircraft Defense Sys	500-1,500	40 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
8 Assorted Lt Armored Veh	3,000-4,000	20 2.75 (111)			
3 Wheeled Veh	4,000-5,000	3,750 20-mm			
30 Troops		5,000 7.62			
10 Dismounted Inf		300 40-mm			
				From a Forward or Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-6. Attack helicopter battalion team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (7th Night)					
4 Antiaircraft Sys	4,000-6,000	36 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
4 Assorted Lt Armored Veh		12 2.75 (111)			
3 Wheeled Veh					
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Team (8th Night)					
4 Tanks	500-1,000	4 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Lt Armored Veh	1,000-1,500	42 2.75	Divergent Engagement		Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
2 Self-Propelled Antiaircraft Sys	1,500-3,000	18 2.75 (111)			
	2,000-4,000	3,750 20-mm		From a Forward or Concealed Position	
20 Dismounted Inf		5,000 7.62			Total Engagement Time IAW Para 4-10e(4)(b)
10 Dismounted Inf		160 40-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-7. Attack helicopter battalion CALFEX/JAAT gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (1st Day)					
6 Tanks	500-1,000	5 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
8 Assorted Lt Armored Veh	1,000-1,500	42 2.75	Divergent Engagement		From a Forward or Concealed Position
2 Self-Propelled Antiaircraft Sys	1,000-3,000	3,750 20-mm		Total Engagement Time IAW Para 4-10e(4)(b)	
30 Dismounted Inf	2,000-4,000	5,000 7.62		Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1	
10 Dismounted Inf		300 40-mm		Suppressed IAW Para 4-10e(1) and Table 4-2	
AH-1 CALFEX/JAAT (2d Day)					
2 Antiaircraft Defense Sys	500-1,500	48 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
6 Assorted Lt Armored Veh	3,000-4,000	3,750 20-mm	Divergent Engagement		Total Engagement Time IAW Para 4-10e(4)(b)
5 Wheeled Veh	4,000-5,000	5,000 7.62		From a Forward or Concealed Position	Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
30 Troops		300 40-mm			Suppressed IAW Para 4-10e(1) and Table 4-2
10 Dismounted Inf					
1 Hand-Held Anti-aircraft Sys					

Table 4-7. Attack helicopter battalion CALFEX/JAAT gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (3d Day)					
6 Tanks	1,000-3,000	5 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
8 Assorted Lt Armored Veh	2,000-3,000	40 2.75			Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
6 Wheeled Veh	4,000-5,000	2,500 20-mm			
30 Troops		4,000 7.62			
		160 40-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 CALFEX/JAAT (4th Day)					
4 Antiaircraft Defense Sys	4,000-6,000	48 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
6 Assorted Lt Armored Veh					Total Engagement Time IAW Para 4-10e(4)(b)
4 Wheeled Veh					
30 Dismounted Troops					
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-7. Attack helicopter battalion CALFEX/JAAT gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (5th Night)					
4 Tanks	1,000-1,500	4 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Lt Armored Veh	2,000-3,000	38 2.75			
3 Wheeled Veh	3,000-4,000	14 2.75 (111)			
30 Troops		3,750 20-mm			
		5,000 7.62			
		160 40-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 CALFEX/JAAT (6th Night)					
2 Antiaircraft Defense Sys	500-1,500	40 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
	3,000-4,000	20 2.75 (111)			
8 Assorted Lt Armored Veh	4,000-5,000	3,750 20-mm			
5 Wheeled Veh		5,000 7.62			
10 Dismounted Inf		300 40-mm			
				From a Forward or Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-7. Attack helicopter battalion CALFEX/JAAT gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (7th Night)					
4 Tanks	500-1,000	4 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit From a Forward or Concealed Position	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Lt Armored Veh	1,500-3,000	42 2.75	Divergent Engagement		Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
2 Self-Propelled Antiaircraft Sys	2,000-4,000	18 2.75 (111)			
10 Dismounted Inf		3,750 20-mm			
		5,000 7.62			Total Engagement Time IAW Para 4-10e(4)(b)
		160 40-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
AH-1 CALFEX/JAAT (8th Night)					
4 Antiaircraft Sys	4,000-6,000	36 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
4 Assorted Lt Armored Veh		12 2.75 (111)			Total Engagement Time IAW Para 4-10e(4)(b)
3 Wheeled Veh					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-8. Air cavalry troop crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (1st Day)					
3 Dismounted Inf	500-1,000	400 7.62	Hover/Terrain Flight	From a Forward or Concealed Position	Suppressed IAW Para 4-10e(1) and Table 4-2
1 Hand-Held Antiaircraft Sys		32 40-mm	Divergent Engagement		Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Crew (2d Day)					
2 Bunker/Gun Pits	500-1,000	6 2.75	Hover/Terrain Flight	Stationary Column or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
3 Assorted Lt Armored Veh	1,000-1,500	1,500 7.62	Divergent Engagement	From a Forward or Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
10 Dismounted Inf		400 7.62			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
3 Dismounted Inf		32 40-mm			Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-8. Air cavalry troop crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-I Crew (3d Day)					
2 Tanks	1,000-1,500	1 TOW/AGES	Hover/Terrain Flight/ Diving Divergent Engagement	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit From a Forward or Concealed Position	Destroyed IAW Para 4-10e(3) and Table 4-2 Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1 Suppressed IAW Para 4-10e(1) and Table 4-2
2 Wheeled Veh	2,000-3,000	10 2.75			
1 Towed Air Defense Sys	3,000-4,000	400 20-mm			
7 Dismounted Inf		1,000 7.62 16 40-mm			
AH-1 Crew (4th Day)					
2 Armored Veh	500-1,000	1 TOW/AGES	Hover/Terrain Flight/ Diving Divergent Engagement	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit From a Forward or Concealed Position	Destroyed IAW Para 4-10e(3) and Table 4-2 Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1 Suppressed IAW Para 4-10e(1) and Table 4-2
3 Wheeled Veh	1,000-3,000	8 2.75			
5 Dismounted Inf		100 20-mm 1,000 7.62			

Table 4-8. Air cavalry troop crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (5th Day)					
3 Assorted Veh	2,000-3,000	6 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
10 Dismounted Troops		200 20-mm			
		1,000 7.62			
		16 40-mm			
AH-1 Crew (6th Day)					
3 Assorted Veh	4,000-6,000	8 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
10 Dismounted Troops					

Table 4-8. Air cavalry troop crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (7th Night)					
3 Assorted Armored Veh	1,000-2,000	6 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
10 Dismounted Troops		2 2.75 (III)			
		200 20-mm			
		1,000 7.62			
		32 40-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Crew (8th Night)					
3 Assorted Armored Veh	1,000-2,000	4 2.75 (III)	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Target Illumination
10 Dismounted Troops	3,000-4,000				

Table 4-9. Air cavalry troop team gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (1st Day)					
6 Assorted Lt Armored Veh	500-3,000	12 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
1 Hand-Held Antiaircraft Sys	1,000-3,000	2,250 20-mm			
20 Dismounted Inf		3,000 7.62			Total Engagement Time IAW Para 4-10e(4)(b)
		160 40-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Team (2d Day)					
3 Tanks	500-1,000	3 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
5 Assorted Lt Armored Veh	2,000-3,000	18 2.75			
7 Dismounted Inf		1,000 20-mm	Divergent Engagement	From a Forward or Concealed Position	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
		3,000 7.62			
		160 40-mm			
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-9. Air cavalry troop team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (3d Day)					
6 Assorted Lt Armored Veh	2,000-3,000	18 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Wheeled Veh		2,000 7.62			
2 Bunkers/Gun Pits		160 40-mm			
20 Dismounted Troops					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Team (4th Day)					
3 Tanks	2,000-3,000	3 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
3 Assorted Lt Armored Veh	4,000-6,000	28 2.75			
2 Bunkers/Gun Pits		2,250 20-mm			
2 Towed Anti-aircraft Sys		3,000 7.62			Total Engagement Time IAW Para 4-10e(4)(b)
20 Dismounted Inf		160 40-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-9. Air cavalry troop team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (5th Day)					
3 Assorted Lt Armored Veh	4,000-6,000	18 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Wheeled Veh					
20 Dismounted Inf					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Team (6th Night)					
6 Assorted Lt Armored Veh	500-1,000	12 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
20 Dismounted Inf	1,000-3,000	6 2.75 (111)			
		2,250 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
		3,000 7.62			
		160 40-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-9. Air cavalry troop team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (7th Night)					
4 Wheeled Veh	2,000-3,000	8 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
20 Dismounted Inf		4 2.75 (III)			
		1,500 7.62			
		300 40-mm			
		750 20-mm			
AH-1 Team (8th Night)					
6 Assorted Lt Armored Veh	4,000-6,000	16 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
4 Wheeled Veh		6 2.75 (III)			
20 Dismounted Inf					

Table 4-10. Air cavalry troop CALFEX/JAAT gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (1st Day)					
6 Assorted Lt Armored Veh	2,000-3,000	18 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Wheeled Veh		2,250 20-mm			
20 Dismounted Troops		3,000 7.62			
		160 40-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 CALFEX/JAAT (2d Day)					
6 Wheeled Veh	500-1,500	24 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Hand-Held Anti-aircraft Sys	3,000-6,000	2,250 20-mm			
		3,000 7.62			
20 Dismounted Inf		160 40-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-10. Air cavalry troop CALFEX/JAAT gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (3d Day)					
4 Tanks	*1,000-1,500	4 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
2 Towed Anti- aircraft Sys	2,000-3,000	18 2.75			
6 Assorted Wheeled Veh		1,500 20-mm		From a Forward or Concealed Position	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
*30 Dismounted Inf		2,000 7.62			
		160 40-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
*Dismounted Inf may come from a concealed position and be engaged as a divergent target.					
AH-1 CALFEX/JAAT (4th Day)					
6 Assorted Wheeled Veh	500-1,500	14 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Lt Armored Veh	4,000-5,000	1,500 20-mm			
		2,000 7.62			
*20 Dismounted Inf		100 40-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
*Dismounted Inf may come from a concealed position and be engaged as a divergent target.					

Table 4-10. Air cavalry troop CALFEX/JAAT gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (5th Night)					
6 Assorted Wheeled Veh	3,000-4,000	12 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Taraget Area IAW Para 4-10e(2) and Table 4-2 Total Engagemnt Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
20 Dismounted Inf		6 2.75 (III)			
		1,500 7.62			
		100 40-mm			
		750 20-mm			
AH-1 CALFEX/JAAT (6th Night)					
4 Tanks	500-1,500	4 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Lt Armored Veh	3,000-5,000	28 2.75			From a Forward or Concealed Position
3 Wheeled Veh		8 2.75 (III)			
2 Towed Anti-aircraft Sys		1,500 20-mm			
30 Dismounted Inf		2,000 7.62			
		100 40-mm			

Table 4-11. Attack helicopter battalion (light inf div) crew gunnery tables

Table 4-11. Attack helicopter battalion (light inf div) crew gunnery tables					
TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (1st Day)					
2 Lt Armored Veh	2,000-3,000	8 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
3 Wheeled Veh		1,000 7.62			
10 Dismounted Troops		400 40-mm	Direct		Total Engagement Time IAW Para 4-10e(4)(b)
		500 20-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Crew (2d Day)					
2 Lt Armored Veh	500-1,000	8 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2)
3 Wheeled Veh	2,000-3,000	500 7.62			
3 Dismounted Inf		16 40-mm	Divergent Engagement	From a Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
		200 20-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-11. Attack helicopter battalion (light inf div) crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (3d Day)					
2 Tanks	*500-1,500	1 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
4 Lt Armored Veh	2,000-3,000	6 2.75			
2 Wheeled Veh	2,000-4,000	1,000 7.62			
*20 Dismounted Inf		32 40-mm			Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
		200 20-mm			
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					*Suppressed IAW Para 4-10e(1) and Table 4-2
*Dismounted Inf may be placed at 500-1,500 meter range if desired.					
AH-1 Crew (4th Day)					
4 Lt Armored Veh	500-1,000	12 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Wheeled Veh	4,000-6,000	500 7.62	Divergent Engagement		
20 Dismounted Inf		32 40-mm			
3 Dismounted Inf		100 20-mm		From a Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-11. Attack helicopter battalion (light inf div) crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (5th Day)					
2 Tanks	500-2,000	1 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
3 Lt Armored Veh	2,000-3,000	12 2.75	Divergent Engagement		
2 Wheeled Veh	4,000-6,000	1,000 7.62			
1 Towed Anti-aircraft Sys		100 40-mm		From a Concealed Position	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
10 Dismounted Troops		200 20-mm			
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
AH-1 Crew (6th Night)					
2 Bunkers/Gun Pits	2,000-3,000	8 2.75	Hover/Terrain Flight/Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
2 Wheeled Veh		6 2.75 (111)			
10 Dismounted Troops		300 20-mm			
		1,000 7.62			Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
		32 40-mm			
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-11. Attack helicopter battalion (light inf div) crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (7th Night)					
1 Tank	2,000-3,000	1 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
2 Lt Armored Veh		6 2.75			Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
10 Dismounted Troops		4 2.75 (I11)			
		500 7.62			Total Engagement Time IAW Para 4-10e(4)(b)
		50 40-mm			
		200 20-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a)
AH-1 Crew (8th Night)					
2 Lt Armored Veh	500-1,500	10 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Wheeled Veh	2,000-4,000	4 2.75 (I11)			
1 Towed Anti- aircraft Sys	4,000-6,000	1,000 7.62	Divergent Engagement	From a Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
1 Bunker/Gun Pit		100 40-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
3 Dismounted Troops		500 20-mm			
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-12. Attack helicopter battalion (light inf div) team gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (1st Day)					
4 Tanks	500-1,500	4 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Armored Veh	2,000-3,000	20 2.75			
2 Wheeled Veh	2,000-4,000	4,000 7.62	Divergent Engagement	From a Forward or Concealed Position	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
20 Dismounted Inf		500 40-mm			
		1,000 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
AH-1 Team (2d Day)					
3 Bunkers/Gun Pits	2,000-3,000	30 2.75	Hover/Terrain Flight/ Diving	Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2)
6 Assorted Wheeled Veh		5,000 7.62			
10 Dismounted Inf		500 40-mm			Total Engagement Time IAW Para 4-10e(4)(b)
		3,750 20-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-12. Attack helicopter battalion (light inf div) team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (3d Day)					
6 Lt Armored Veh	500-1,500	70 2.75	Hover/Terrain Flight/ Diving Divergent Engagement	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
12 Wheeled Veh	4,000-6,000	5,000 7.62			
40 Troops		500 40-mm			
10 Dismounted Inf		3,000 20-mm			
				From a Forward or Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1 Suppressed IAW Para 4-10e(1) and Table 4-2
AH-1 Team (4th Day)					
2 Armored Veh	500-1,500	4 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Wheeled Veh	1,000-2,000	42 2.75			
2 Towed Anti- aircraft Sys	2,000-3,000	5,000 7.62			Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
	2,000-4,000	500 40-mm			
1 Hand-Held Anti- aircraft Sys		3,750 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
30 Troops					
3 Dismounted Inf					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1 Suppressed IAW Para 4-10e(1) and Table 4-2
2 Gun Pits					

Table 4-12. Attack helicopter battalion (light inf div) team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (5th Night)					
3 Bunker/Gun Pits	2,000-3,000	30 2.75	Hover/Terrain Flight/ Diving	Stationary Column or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
6 Assorted Wheeled Veh		10 2.75 (I11)			
20 Dismounted Inf		5,000 7.62			
		500 40-mm			
		3,750 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Team (6th Night)					
4 Tanks	500-1,500	4 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Armored Veh	2,000-3,000	20 2.75			
2 Wheeled Veh	2,000-4,000	10 2.75 (I11)	Divergent Engagement	From a Forward or Concealed Position	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
20 Dismounted Inf		4,000 7.62			
		500 40-mm			
		1,000 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-12. Attack helicopter battalion (light inf div) team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (7th Night)					
6 Lt Armored Veh	500-1,500	50 2.75	Hover/Terrain Flight/ Diving Divergent Engagement	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit From a Forward or Concealed Position	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1 Suppressed IAW Para 4-10e(1) and Table 4-2
12 Wheeled Veh	4,000-6,000	70 2.75 (111)			
40 Troops		5,000 7.62			
10 Dismounted Inf		500 40-mm			
		3,000 20-mm			
AH-1 Team (8th Night)					
2 Armored Veh	500-1,500	4 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2 Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
6 Wheeled Veh	1,000-2,000	42 2.75			
2 Towed Anti- aircraft Sys	2,000-3,000	12 2.75 (111)			Total Engagement Time IAW Para 4-10e(4)(b)
	2,000-4,000	5,000 7.62			
30 Troops	4,000-6,000	500 40-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
1 Hand-Held Anti- aircraft Sys		3,750 20-mm			
3 Dismounted Inf					
2 Gun Pits					

Table 4-13. Attack helicopter battalion (light inf div) CALFEX/JAAT gunnery tables

<u>TARGET ARRAY</u>					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (1st Day)					
4 Tanks	500-1,500	4 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Armored Veh	2,000-3,000	20 2.75			Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Wheeled Veh	2,000-4,000	4,000 7.62			
20 Dismounted Inf		500 40-mm			
		1,000 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 CALFEX/JAAT (2d Day)					
3 Bunker/Gun Pits	2,000-3,000	30 2.75	Hover/Terrain Flight/ Diving	Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
6 Assorted Wheeled Veh		5,000 7.62			
		500 40-mm			
20 Dismounted Inf		3,750 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-13. Attack helicopter battalion (light inf div) CALFEX/JAAT gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (3d Day)					
6 Lt Armored Veh	500-1,500	70 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
12 Wheeled Veh	4,000-6,000	5,000 7.62			
40 Dismounted Troops		500 40-mm			
10 Dismounted Inf		3,000 20-mm			
2 Bunker/Gun Pits					
AH-1 CALFEX/JAAT (4th Day)					
2 Armored Veh	500-1,500	4 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Wheeled Veh	1,000-2,000	42 2.75			
2 Towed Anti- aircraft Sys	2,000-3,000	5,000 7.62			Neutralized; Cover- age of Target Area IAW Para 4-10e(2)
1 Hand-Held Anti- aircraft Sys	2,000-4,000	500 40-mm			
30 Troops		3,750 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
3 Dismounted Inf					
2 Gun Pits			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1		

Table 4-13. Attack helicopter battalion (light inf div) CALFEX/JAAT gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (5th Night)					
3 Bunker/Gun Pits	2,000-3,000	30 2.75	Hover/Terrain Flight/ Diving	Stationary Column or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
6 Assorted Wheeled Veh		10 2.75 (111)			
		5,000 7.62			
20 Dismounted Inf		500 40-mm			
		3,750 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 CALFEX/JAAT (6th Night)					
4 Assorted Armored Veh	500-1,500	4 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
	2,000-3,000	40 2.75			
6 Wheeled Veh	4,000-6,000	12 2.75 (111)			
2 Towed Anti- aircraft Sys		4,000 7.62			
30 Troops		300 40-mm			Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
10 Dismounted Inf		2,500 20-mm			
2 Gun Pits					
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-14. Air cavalry troop (light inf div) crew gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (1st Day)					
3 Dismounted Inf	500-1,000	400 7.62	Hover/Moving	From a Concealed Position	Suppression; Coverage of Target Area IAW Para 4-10e(1) and Table 4-2
2 Hand-Held Anti-aircraft Sys			Divergent Engagement		Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Crew (2d Day)					
2 Bunker/Gun Pits	500-1,000	6 2.75	Hovering/Moving/Diving	Moving or Stationary	Neutralized; Coverage of Target Area IAW Para 4-10e(2)
3 Assorted Armored Veh	1,000-1,500	1,500 7.62	Divergent Engagement	From a Forward or Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
10 Dismounted Troops		400 7.62			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
3 Dismounted Troops		32 40-mm			Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-14. Air cavalry troop (light inf div) crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (3d Day)					
2 Wheeled Veh	1,000-1,500	1 TOW/AGES	Hover/Terrain Flight/ Diving Divergent Engagement	Stationary	Destroyed IAW Para 4-10e(3) and Table 4-2
1 Towed ADA Sys	2,000-3,000	10 2.75		From a Concealed Position	
2 Tanks	3,000-4,000	400 20-mm			Neutralized; Coverage of Target Area IAW Para 4-10e(2)
7 Dismounted Inf		1,000 7.62			
		16 40-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
AH-1 Crew (4th Day)					
3 Wheeled Veh	500-1,000	1 TOW/AGES	Hover/Terrain Flight	Moving Column	Destroyed IAW Para 4-10e(3) and Table 4-2
2 Armored Veh	1,000-3,000	8 2.75		From a Concealed Position	
5 Dismounted Inf		1,000 7.62			Neutralized; Coverage of Target Area IAW Para 4-10e(2)
		32 40-mm			
		32 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-14. Air cavalry troop (light inf div) crew gunnery tables (continued)

Table 4-14. Air cavalry troop (light inf div) crew gunnery tables (continued)					
TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (5th Day)					
3 Assorted Veh	2,000-3,000	6 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2)
10 Dismounted Troops		1,000 7.62			Total Engagement Time IAW Para 4-10e(4)(b)
		16 40-mm			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Crew (6th Day)					
3 Assorted Veh	4,000-6,000	8 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
10 Dismounted Troops					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-14. Air cavalry troop (light inf div) crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (7th Night)					
3 Assorted Armored Veh	1,000-2,000	6 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, or Stationary	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
10 Dismounted Troops		2 2.75 (111)			
		1,000 7.62			
		32 40-mm			
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Crew (8th Night)					
3 Assorted Armored Veh	1,000-2,000	4 2.75 (111)	Hover/Terrain Flight	Moving Column, Attacking Line, or Stationary	Target Illumination
10 Dismounted Troops	3,000-4,000				

Table 4-14. Air cavalry troop (light inf div) crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Crew (9th Night)					
4 Assorted Armored Veh	4,000-6,000	8 2.75 (HE)	Hover/Terrain Flight	Moving Column, Attacking Line, or Stationary	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
10 Dismounted Troops		*2-4 2.75 (III)			
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
*Optional; may be illuminated by other means.					

Table 4-15. Air cavalry troop/squadron (light inf div) gunnery tables

<u>TARGET ARRAY</u>					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (1st Day)					
6 Assorted Armored Veh	500-3,000	12 2.75 (HE)	Hover/Terrain Flight	Moving Column, Attacking Line, or Stationary	Neutralized; Coverage of Target Area IAW Para 4-10e(2)
	1,000-3,000	3,000 7.62			
1 Hand-Held Anti-aircraft Sys		150 40-mm			
20 Dismounted Inf					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Team (2d Day)					
2 Tanks	500-1,000	2 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, or Stationary	Destroyed IAW Para 4-10e(3) and Table 4-2
3 Assorted Armored Veh	2,000-3,000	8 2.75 (HE)	Divergent Engagement		
		1,000 7.62		From a Concealed Position	Neutralized; Coverage of Target Area IAW Para 4-10e(2)
7 Dismounted Inf		50 40-mm			
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-15. Air cavalry troop/squadron (light inf div) gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (3d Day)					
6 Assorted Lt Armored Veh	2,000-3,000	18 2.75 (HE)	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
2 Wheeled Veh		2,000 7.62			
2 Bunker/Gun Pits		160 40-mm			
20 Dismounted Troops					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Team (4th Day)					
3 Tanks	2,000-3,000	3 TOW/AGES	Hover/Terrain Flight	Moving Column or Stationary	Destroyed IAW Para 4-10e(3) and Table 4-2
3 Assorted Armored Veh	4,000-6,000	18 2.75 (HE)			
20 Dismounted Inf					
2 Towed Anti-aircraft Sys					Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-15. Air cavalry troop/squadron (light inf div) gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (5th Day)					
3 Assorted Armored Veh	4,000-6,000	18 2.75 (HE)	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
2 Wheeled Veh					Total Engagement Time IAW Para 4-10e(4)(b)
20 Dismounted Inf					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Team (6th Night)					
6 Assorted Armored Veh	500-1,000	12 2.75 (HE)	Hover/Terrain Flight/Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
20 Dismounted Inf	1,000-3,000	6 2.75 (III)			Total Engagement Time IAW Para 4-10e(4)(b)
		3,000 7.62			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
		160 40-mm			Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-15. Air cavalry troop/squadron (light inf div) gunnery tables (continued)

Table 4-15. Air cavalry troop/squadron (light inf div) gunnery tables (continued)					
TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Team (7th Night)					
4 Wheeled Veh	2,000-3,000	8 2.75 (HE)	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
20 Dismounted Inf		4 2.75 (I11)			
		1,500 7.62			
		300 40-mm			
AH-1 Team (8th Night)					
6 Assorted Armored Veh	4,000-6,000	12 2.75 (HE)	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
4 Wheeled Veh		6 2.75 (I11)			
20 Dismounted Inf					

Table 4-16. Air cavalry troop (light inf div) gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (1st Day)					
6 Assorted Armored Veh	2,000-3,000	18 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Wheeled Veh		3,000 7.62			
20 Dismounted Troops		150 40-mm			
		2,250 20-mm			
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 CALFEX/JAAT (2d Day)					
6 Wheeled Veh	500-1,500	24 2.75 (HE)	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
2 Hand-Held Anti-aircraft Sys	3,000-6,000	3,000 7.62			
20 Dismounted Inf		160 40-mm			
		2,250 20-mm			
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-16. Air cavalry troop (light inf div) gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (3d Day)					
4 Tanks	*1,000-1,500	4 TOW/AGES	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, or Stationary	Destroyed IAW Para 4-10e(3) and Table 4-2
2 Towed Anti- aircraft Sys	2,000-3,000	18 2.75 (HE)			
6 Assorted Wheeled Veh		2,000 7.62		*From a Forward or Concealed Position	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
*30 Dismounted Inf		160 40-mm			
		1,500 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					*Suppressed IAW Para 4-10e(1) and Table 4-2
*Dismounted Inf may come from a concealed position and be engaged as a divergent target.					

Table 4-16. Air cavalry troop (light inf div) gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (4th Day)					
2 Lt Armored Veh	500-1,500	14 2.75	Hover/Terrain Flight	Moving Column, Attacking Line, or Stationary	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
6 Assorted Wheeled Veh	4,000-5,000	2,000 7.62			
*20 Dismounted Inf		100 40-mm			
		1,500 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					*Suppressed IAW Para 4-10e(1) and Table 4-2
*Dismounted Inf may come from a concealed position and be engaged as a divergent target.					

Table 4-16. Air cavalry troop (light inf div) gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 CALFEX/JAAT (5th Night)					
6 Assorted Wheeled Veh	3,000-4,000	12 2.75	Hover/Terrain Flight/ Diving	Moving Column, Attacking Line, or Stationary	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
20 Dismounted Inf		6 2.75 (I11)			
		1,500 7.62			
		100 40-mm			
		750 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 CALFEX/JAAT (6th Night)					
4 Tanks	500-1,500	4 TOW/AGES	Hover/Terrain Flight	Moving Column, Attacking Line, or Stationary	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Armored Veh	3,000-5,000	18 2.75			
3 Wheeled Veh		8 2.75 (I11)			
2 Towed Anti-aircraft Sys		2,000 7.62			
30 Dismounted Inf		100 40-mm		From a Concealed Position	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
		1,500 20-mm			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-17. AH-64 commander's gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Commander (Gunner/Day)					
1 Lt Armored Veh	500-1,500	20 30-mm (IHADSS) ¹	Moving	Moving	Destroyed
1 Lt Armored ADA	1,500-2,500	20 30-mm (TADS-DVO) ¹	Hovering	Stationary	Suppressed
3 Dismounted Inf	2,000-3,000	20 30-mm (TADS-DTV) ¹		Stationary or Moving	Neutralized
1 Tank	3,000-6,000	20 30-mm (IHADSS)			
2 Tanks	4,000-7,000	Hellfire/Simulation (LOBL Ops) ¹			
		Hellfire/Simulation (LOAL Ops) ²			
¹ Employed with laser designator/range finder (autonomous/remote) where laser operations are permitted. ² Training missiles should be employed to the extent possible to gain maximum use of laser range facilities.					
AH-64 Commander (Gunner/Night)					
1 Lt Armored Veh	500-1,500	20 30-mm (IHADSS) ¹	Hover/Terrain Flight	Moving	Destroyed
1 Lt Armored ADA	1,500-2,500	20 30-mm (TADS-FLIR) ¹		Stationary	Neutralized
1 Tank	3,000-5,000	Hellfire (LOBL Ops) ²			
	4,000-6,000	Hellfire (LOAL Ops) ²			
¹ Employed with laser designator/range finder (autonomous/remote) where laser operations are permitted. ² Training missiles should be employed to the extent possible to gain maximum use of laser range facilities.					

Table 4-17. AH-64 commander's gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Commander (Pilot/Day)					
2 Lt Armored Veh	500-1,500	6 2.75 (IHADSS) ³	Hover/Terrain Flight	Moving	Destroyed
5 Dismounted Inf	1,500-2,500	20 30-mm (IHADSS)		Moving or Stationary	Suppressed
4 Armored Veh	2,000-3,000	6 2.75 (COOP) ³			Neutralized
2 Tanks	3,000-6,000	2 Hellfire/ Simulation (LOBL Ops) ^{1,2}			
	4,000-6,000				
	4,000-7,000	2 Hellfire/ Simulation (LOAL Ops) ^{1,2}			
¹ Employed with laser designator/range finders (autonomous/remote) where laser operations are permitted. ² Training missiles should be employed to the extent possible to gain maximum use of laser range facilities. ³ Ammunition (2.75") should include MPSM and smoke as required.					
AH-64 Commander (Pilot/Night)					
2 Lt Armored Veh	500-1,500	6 2.75 (IHADSS) ³	Hover/Terrain Flight	Stationary	Destroyed
1 Lt Armored Veh	2,000-3,000	20 30-mm (IHADSS)		Moving or Stationary	Suppressed/ Neutralized
2 Tanks	2,500-3,500	6 2.75 (COOP) ³			Neutralized
4 Tanks	3,000-5,000	Hellfire/Simulation (LOAL/Ops) ^{1,2}			
	4,000-7,000				
¹ Employed with laser designator/range finders (autonomous/remote) where laser operations are permitted. ² Training missiles should be employed to the extent possible to gain maximum use of laser range facilities. ³ Ammunition (2.75") should include MPSM and smoke as required.					

Table 4-18. AH-64 crew gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Crew (1st Day)					
1 Tank	3,000-5,000	1 Hellfire/Simulated (LOBL-Norm)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
4 Tanks		10 2.75 (COOP-Dir)			Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1 Suppressed IAW Para 4-10e(1) and Table 4-2
AH-64 Crew (2d Day)					
1 Lt Armored Veh	1,000-1,500	40 30-mm (IHADSS-CPG)	Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
2 Lt Armored Veh	1,500-2,500	6 2.75 (IHADSS-P)			Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-18. AH-64 crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Crew (3d Day)					
2 Lt Armored Veh	1,500-2,500	60 30-mm (TADS)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1 Suppressed IAW Para 4-10e(1) and Table 4-2
	2,000-3,000	8 2.75 (IHADSS-P)			
AH-64 Crew (4th Day)					
2 Tanks	4,000-6,000	12 2.75 (COOP-Indir)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1 Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-18. AH-64 crew gunnery tables (continued)

Table 4-18. AH-64 crew gunnery tables (continued)					
TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Crew (5th Day)					
2 Lt Armored Veh	2,000-3,000	60 30-mm (TADS)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
4 Tanks	4,000-7,000	4 Hellfire/Simulated (LOAL-Dir-P)			Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
AH-64 Crew (6th Day)					
20 Troops	500-1,000	40 30-mm (IHADSS-P)	Terrain Flight	From a Forward or Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-18. AH-64 crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Crew (7th Day)					
4 Assorted Armored Veh	4,000-6,000	10 2.75 (COOP-Dir)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-64 Crew (8th Day)					
4 Tanks	500-1,500	4 Hellfire/Simulated (LOBL-RIPL)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
20 Troops	3,000-6,000	40 30-mm (IHADSS-P)	Divergent Engagement	From a Forward or Concealed Position	Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1 Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-18. AH-64 crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Crew (9th Day)					
4 Tanks	3,000-5,000	4 Hellfire/Simulated (LOBL-Norm-Rapid)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-1 Crew (10th Day)					
2 Tanks	500-1,500	2 Hellfire/Simulated (LOBL-LO-P)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
1 Lt Armored Veh	4,000-7,000	40 30-mm (IHADSS-CPG)			Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-18. AH-64 crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Crew (1st Night)					
4 Tanks	3,000-5,000	4 Hellfire/Simulated (LOBL-RIPL)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-64 Crew (2d Night)					
1 Lt Armored Veh	500-1,000	40 30-mm (IHADSS-P)	Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2 Total Engagement Time IAW Para 4-10e(4)(b) Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1

Table 4-18. AH-64 crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Crew (3d Night)					
1 Tank	500-1,500	1 Hellfire/Simulated (LOBL-Norm)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
1 Lt Armored Veh	3,000-4,000	40 30-mm (IHADSS-P)			Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-64 Crew (4th Night)					
2 Lt Armored Veh	1,500-2,500	60 30-mm (TADS)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Total Engagement Time IAW Para 4-10e(4)(b)
	2,000-3,000	8 2.75 (IHADSS-P)			Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-18. AH-64 crew gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Crew (5th Night)					
2 Tanks	500-1,500	2 Hellfire/Simulated (LOAL HI-P)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
1 Lt Armored Veh	4,000-6,000	40 30-mm (IHADSS-CPG)			Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
AH-64 Crew (6th Night)					
4 Tanks	3,000-5,000	12 2.75 (COOP-Dir)	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-19. AH-64 team gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE(M) ¹	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Team (1st Night)					
4 Tanks	500-1,500	45 2.75 FFAR ²	Hovering	Moving Column, Attacking Line,	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Lt Armored Veh	2,000-4,000	4 Hellfire ³	Terrain Flight	Stationary Column, or Stationary Assembled Unit	Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
3 Wheeled Veh	2,500-4,500	150 30-mm	Hover/Terrain Flight		
			Divergent Engagement	From a Forward or Concealed Position	
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

¹Targets should be placed so that they are within the range given for the type ammunition being used.

²Ammunition (2.75") should include MPSM and smoke as required.

³Use of training missiles will permit multiple simulated engagements where laser operations are permitted.

Table 4-19. AH-64 team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M) ¹	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Team (2d Night)					
4 Tanks	500-1,500	45 2.75 FFAR ²	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Lt Armored Veh	2,000-4,000	4 Hellfire ³	Terrain Flight		Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
3 Wheeled Veh	2,500-4,500	150 30-mm	Hover/Terrain Flight		
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
¹ Targets should be placed so that they are within the range given for the type ammunition being used. ² Ammunition (2.75") should include MPSM and smoke as required. ³ Use of training missiles will permit multiple simulated engagements where laser operations are permitted.					

Table 4-19. AH-64 team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE (M) ¹	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Team (1st Day)					
4 Tanks	500-1,500	60 2.75 FFAR ²	Hovering	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Lt Armored Veh	1,000-3,000	4 Hellfire ³	Terrain Flight		
4 Wheeled Veh	3,000-6,000	150 30-mm	Hover/Terrain Flight		Neutralized; Coverage of Target Area IAW Para 4-10e(2) and Table 4-2
10 Dismounted Inf	4,000-7,000		Divergent Engagement	From a Forward or Concealed Position	
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

¹Targets should be placed so that they are within the range given for the type ammunition being used.
²Ammunition (2.75") should include MPSM and smoke as required.
³Use of training missiles will permit multiple simulated engagements where laser operations are permitted.

Table 4-19. AH-64 team gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M) ¹	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 Team (2d Day)					
4 Tanks	500-1,500	60 2.75 FFAR ²	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column or Stationary Assembled Unit From a Forward or Concealed Position	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Lt Armored Veh	1,000-3,000	4 Hellfire ³	Divergent Engagement		Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
4 Wheeled Veh	3,000-6,000	150 30-mm			Total Engagement Time IAW Para 4-10e(4)(b)
10 Dismounted Inf					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
¹ Targets should be placed so that they are within the range given for the type ammunition being used.					
² Ammunition (2.75") should include MPSM and smoke as required.					
³ Use of training missiles will permit multiple simulated engagements where laser operations are permitted.					

Table 4-20. AH-64 CALFEX/JAAT gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE(M) ¹	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 CALFEX/JAAT (1st Day)					
5 Tanks	3,000	120 2.75 ²	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
8 Assorted Lt Armored Veh	6,000	5 Hellfire/ Simulation ³			Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
6 Wheeled Veh	1,000-3,000	300 30-mm			
20 Dismounted Inf	4,000-7,000				
					Total Engagement Time IAW Para 4-10e(4)(b)
					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2

Table 4-20. AH-64 CALFEX/JAAT gunnery tables (continued)

TARGET ARRAY					
DESCRIPTION	RANGE(M) ¹	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-64 CALFEX/JAAT (2d Day)					
4 Tanks	500-1,500	90 2.75 ²	Hover/Terrain Flight	Moving Column, Attacking Line, Stationary Column, or Stationary Assembled Unit	Destroyed IAW Para 4-10e(3) and Table 4-2
6 Assorted Lt Armored Veh	2,500-4,500	3 Hellfire/ Simulation ³			Neutralized; Cover- age of Target Area IAW Para 4-10e(2) and Table 4-2
4 Wheeled Veh		300 30-mm			Total Engagement Time IAW Para 4-10e(4)(b)
20 Troops					Total Exposure Time Per Engagement IAW Para 4-10e(4)(a) and Chart 4-1
					Suppressed IAW Para 4-10e(1) and Table 4-2
¹ Targets should be placed so that they are within the range given for the type ammunition being used. ² Ammunition (2.75") should include MPSM and smoke as required. ³ Use of training missiles will permit multiple simulated engagements where laser operations are permitted.					

Table 4-21. Simulation gunnery tables

TARGET ARRAY					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Simulation (Gunner)					
Tanks	2,000-3,000	2 TOW (TSU)	Hover/Moving	Stationary/Moving	Destroyed
Lt Armored Veh	500-2,000	250 20-mm (TSU)	Hover/Moving	Stationary/Moving	Suppressed/ Neutralized
Lt Wheeled Veh	500-2,000	250 20-mm (HSS)	Hover/Moving	Stationary/Moving	Suppressed/ Neutralized
Lt Armored Veh	500-1,500	20 2.75 (Plt Override)	Hover/Moving	Stationary/Moving	Suppressed
Lt Wheeled Veh	1,000-6,000	20 2.75 (Plt Override)	Hover/Moving	Stationary/Moving	Suppressed
Lt Armored Veh	500-2,000	250 20-mm (HSS to TSU)	Hover/Moving	Stationary/Moving	Suppressed/ Neutralized
Tanks	500-2,000	2 TOW (TSU)	Hover/Moving	Stationary/Moving	Destroyed
AH-64 Simulation (Pilot)					
1 Lt Armored Veh	500-4,000	4 2.75 (Direct)	Hover/Terrain Flight	Stationary	Neutralized
1 Lt Armored Veh	< 6,000	4 27.5 (Indirect)	Hover/Terrain Flight	Stationary	Neutralized
1 Lt Armored Veh	500-4,000	4 2.75 (Stadiametric)	Hover/Terrain Flight	Stationary	Neutralized
1 Lt Armored Veh	< 2,000	40 20-mm (HSS)	Hover/Terrain Flight	Stationary	Suppressed
1 Lt Armored Veh	< 2,000	40 20-mm (Fixed)	Hover/Terrain Flight	Stationary	Suppressed

Table 4-21. Simulation gunnery tables (continued)

<u>TARGET ARRAY</u>					
DESCRIPTION	RANGE(M)	AMMUNITION	MODE	TARGET CONDITION	TARGET EFFECT
AH-1 Simulation (Crew)					
2 Tanks	3,000-3,500	2 TOW	Hover	Stationary	Hit
Lt Armored Veh	1,000-2,000	200 20-mm		Stationary	Suppressed
2 Tanks	2,000-3,000	2 TOW	Moving	Stationary	Hit
Lt Wheeled Veh	1,500-2,000	200 20-mm		Stationary	Suppressed
2 Tanks	2,600-3,500	2 TOW	Hover	Moving	Hit
Lt Armored Veh	1,000-2,000	6 2.75 FFAR	Hover	Stationary	Neutralized
Lt Armored Veh	750-1,500	100 20-mm	Moving	Stationary	Hit
Lt Armored Veh	2,000-3,500	10 2.75 FFAR		Moving	Neutralized
Lt Armored Veh	500-1,500	100 20-mm	Hover	Stationary	Hit
Wheeled Veh	> 6,000	10 2.75 FFAR	Hover	Stationary	Suppressed

DOOR GUNNERY

4-11. AERIAL DOOR GUNNERY TRAINING

Helicopter door gunnery consists of those techniques used to acquire and engage enemy personnel and other targets while the helicopter is operating at terrain flight altitudes. Specifically, the door gunner visually acquires and identifies potential and actual battlefield targets. He responds by providing suppressive fires on these targets. This section discusses techniques required of the gunner to place effective fire on a target.

a. The basic weapon for the helicopter door gunner is the M60D, 7.62-millimeter machine gun. The three armament subsystems for the utility helicopter and cargo helicopter vary only in mounting, auxiliary equipment, and basic load. Detailed descriptions of these subsystems are contained in TM 9-1005-262-14. A door gunnery training program should emphasize weapons qualification, aerial firing qualification, and target acquisition.

b. Helicopter door gunnery in a high-threat environment will present new challenges. Door gunnery in principle has not changed; it still consists of a team—the pilot and the gunner. The pilot provides early warning of targets to be engaged. The gunner operates one machine gun in an effort to suppress or destroy the enemy while he is detecting other targets and alerting the pilot. However, the door gunner's environment is now different. It has changed as a result of three factors: the high-threat battlefield, terrain flight, and aircraft design changes.

(1) The high-threat battlefield means the door gunner must be concerned with an enemy threat that will be more complex, sophisticated, and lethal than before. Therefore, his target acquisition efforts must be extended beyond the immediate area of the aircraft. He must be concerned with the possibility that his aircraft may be engaged by hostile aircraft, long-range anti-air weapons, and numerous ground weapons.

(2) Terrain flying makes the door gunner and his aircraft more vulnerable to small arms fire. It also makes target acquisition more difficult because the terrain may allow only a fleeting glimpse of the enemy. The gunner must identify and engage the target immediately, almost to the point of firing by instinct. Also, the door gunner must continually divide his attention between observation of the area and assistance in obstacle clearance.

(3) Aircraft design changes restrict the gunner's forward field of view. Therefore, the pilot/copilot and the gunner must coordinate closely to ensure accurate handover with minimum delay.

4-12. TRAINING PROGRAM

a. Door gunnery personnel are wartime TOE additions to units equipped with utility or cargo helicopters. This augmentation creates a training dilemma. Door gunners are a tactical necessity and must be trained. However, such personnel are seldom, if ever, found in units during peacetime. Ideally, in the event of mobilization and deployment, door gunners will be school-trained and assigned to such units. Therefore, very few aviation units currently conduct door gunnery training. Unit commanders must be prepared, however, to integrate qualified door gunners into their training program. They must also conduct their own training program for newly assigned personnel or train door gunners from their current personnel assets. Anyone in a unit, from a company clerk to a wheeled-vehicle mechanic, may be called upon to perform the duties of a door gunner. It is possible that no one in the unit may be qualified with the M60 machine gun.

b. Given the wide range of individual qualifications, the door gunnery training program should be highly flexible and open-ended. Each person assigned to a unit as a door gunner must be evaluated to assess the amount and type of training he requires. For example, a soldier who has already qualified with an M60 machine gun on the ground would integrate directly into the aerial gunnery phase of training.

(1) An aerial door gunnery training program should qualify any trainee in the techniques, skills, and duties of the door gunner. The primary emphasis is on initial weapons qualification, aerial firing qualification, and target acquisition.

(2) The training program may be modified and designed to meet the needs of the unit and the trainee concerned. For example, the first module (Table 4-22) is basic weapons qualification. Table 4-22 is a prerequisite to the second module, aerial qualification (Table 4-23). Each module is the building block that provides the foundation for the next. The first two modules contain the basic door gunnery qualification course. The last module (Table 4-24) contains subjects that may be added to the basic course commensurate with additional duties assigned to the door gunner.

Table 4-22. Training Module I (basic weapons qualification)

Training Objective: To provide initial M60D* qualification for enlisted personnel assigned to door gunnery positions.

SUBJECT	SCOPE	REFERENCE
Operation and Function of the M60D	Conference to provide the basic knowledge of how the components function and their interrelationship during operation	FM 23-67
Assembly, Disassembly, and Nomenclature of the M60D	Demonstration and practical exercise on the general and detailed assembly, disassembly, and nomenclature of the M60D machine gun	FM 23-67
Malfunctions, Stoppages, Immediate Action, and Maintenance	Conference to provide information concerning abnormal operation, corrective action, and maintenance	FM 23-67
Range Estimation	Conference/practical exercise to provide information on the methods of determining the distance between gunner and target	FM 23-67
Fire Control/Fire Commands	Conference to provide information on the various methods used in controlling and effectively delivering fires	FM 23-67
M60D Machine Gun Familiarization Firing	Practical exercise in familiarization firing in preparation for record fire (Tables I-IV in FM 23-67)	Range SOP and FM 23-67
M60D Machine Gun Record Fire	Practical exercise/record fire to provide qualification with the M60D machine gun	Range SOP and FM 23-67

*The M60D, 7.62-millimeter machine gun is the basic helicopter door gunnery weapon.

Table 4-23. Training Module II (aerial qualification)

Training Objective: To qualify selected personnel in the techniques, skills, and duties of aerial door gunners.

SUBJECT	SCOPE	REFERENCE
Duties of the Door Gunner	Conference on the duties of door gunners	Unit SOP and FM 90-4
Aircraft Familiarization and Orientation	Conference and practical exercise to familiarize the student with unit aircraft, to include capabilities and configuration	Appropriate aircraft operator's manual (-10)
Techniques of Fire and Employment	Conference on the principles and techniques of aerial machine gun firing	
Ballistics	Aerial ballistics pertaining to spin-stabilized projectiles	FM 1-140
Armament Subsystem Introduction	Conference to provide a working knowledge of the appropriate armament subsystem, to include nomenclature, safety procedures, and operator maintenance	TM 9-1005-262-14
High-Threat Environment	Conference to familiarize door gunners with the high-threat environment, to include Threat aircraft and equipment and their employment	FMs 1-402, 17-95, and 44-30
Visual Search and Target Detection	Conference on the techniques of visual search, to include limitations and procedures of target detection	FM 17-35
Crew Member Emergency Procedures	Conferences and demonstration of duties and actions taken by the door gunner during in-flight and forced landing emergencies	Operator's manual (-10) and unit SOP
Night Gunnery	Conference on techniques and procedures of night firing	Unit SOP, range SOP, and FM 1-204
Aerial Gunnery Qualification	Practical exercise and evaluation in aerial gunnery firing with appropriate armament subsystem	Range SOP, FM 23-67, and TM 9-1005-262-14
Aeromedical Training	Conference on the principles of first aid, to include capabilities and limitations of the human body in the aviation environment	FMs 21-11 and 1-301
Survival, Escape, and Evasion	Conference on evading the enemy and on basic survival following a forced landing	FM 21-76

Table 4-23. Training Module II (aerial qualification) (continued)

SUBJECT	SCOPE	REFERENCE
M24 Gas Mask	Conference and practical exercise on description, capabilities, limitations, and procedures for wearing the M24 gas mask	TM 3-4240-280-10

Table 4-24. Training Module III (advanced training)

Training Objective: To provide aerial door gunners that training required to qualify them to perform the additional duty of assistant crew chief and to assist in navigation.

SUBJECT	SCOPE	REFERENCE
Airframe and Airframe Components	Conference on major sections of the airframe structure and the location of the major compartments and the contents of each, to include a walk-around inspection	All reference material contained in aircraft technical manual series
Flight Controls	Conference on flight control and hydraulic systems with emphasis on inspection and servicing	
Power Plant and Related Systems	Conference on the engine(s), fuel, and engine lubrication systems with emphasis on inspection and servicing	
Loads	Conference and practical exercise on internal and external loading, to include radio procedures, crew coordination, and hand-and-arm signals	
Power Train	Conference on the power train system(s) location, inspection, and servicing	
Rotor Systems	Conference on the rotor system and on components location, inspection, and servicing	
Inspections	Practical exercise on daily inspections, with emphasis on pre-flight, postflight, and servicing	
Ground Handling and Servicing	Conference on ground handling, refueling procedures, and care and handling of POL	

4-13. PERSONNEL REQUIREMENTS

a. Unit Trainer. The commander should designate a unit trainer within each platoon who will be responsible for training new personnel and sustaining current personnel. Ideally, the unit trainer would be the platoon sergeant or the most experienced crew chief in the platoon. The unit trainer will—

- Be a qualified, current door gunner.
- Be on board when new personnel familiarize or qualify in the aircraft.
- Organize all training modules.
- Supervise the teaching of all training modules.
- Evaluate qualification tables.
- Maintain records on all door gunnery personnel.

NOTE: The unit may designate more than one unit trainer.

b. Door Gunners. To maintain currency, each door gunner must execute the tasks in the following tables and modules once annually as a minimum. Commanders may require additional training based on individual and unit needs and available resources.

- Table VI (all tasks).
- Training Module I (tasks 1 through 5).
- Training Module II (all tasks).

4-14. M60D AMMUNITION AUTHORIZATION, FIRING TABLES, AND STANDARDS

a. Ammunition Authorization. Ammunition authorization is based on the number of airframes required. STRAC will allocate enough 7.62-millimeter ammunition to maintain one door gunner per authorized TOE airframe per year. The

number of airframes required (by TOE/MTOE) is multiplied by the total rounds authorized (Table 4-25).

b. Firing Tables I Through VII.

(1) Tables I through IV (basic marksmanship), found in FM 23-67, are required for initial weapons familiarization *only*. These tables are *not required* for individuals who have completed initial familiarization.

(2) Table V is for familiarization or practice for transition in aircraft. This table is shown in Table 4-26. Table VI is the same as Table V but is used for record fire. Table VII is also based on Table V but is conducted at night or in protective masks at the discretion of the commander.

4-15. FUNDAMENTALS OF FIRE CONTROL

a. Fire control, or weapon control, is the name given to all the observations, calculations, and actions involved in firing a weapon. Broadly defined, fire control includes all means of directing munitions of all kinds in such a way that they will strike the target with a minimum expenditure of ammunition.

(1) In nearly all gun systems, the basic elements are the same. The line of sight is the direction from the gun to the target. The line of aim is offset from the line of sight by an amount determined by—

- Target motion.
- Gun station (helicopter) motion.
- Range.
- Gravity drop of the projectile.
- Windage.
- Characteristics of the gun and the projectile.

Table 4-25. Ammunition rounds authorized by table

<u>Table</u>	<u>Rounds</u>	<u>Reference</u>
I (basic marksmanship--bipod firing)	42	FM 23-67, p 9-12
II (basic marksmanship--tripod firing, practice)	108	FM 23-67, p 9-19
III (basic marksmanship--tripod firing, record practice)	78	FM 23-67, p 9-19
IV (basic marksmanship--tripod firing, record)	108	FM 23-67, p 9-20
V (transition in aircraft--practice)	150	
VI (transition in aircraft--record)	150	
VII (transition in aircraft--night or NBC)	150	
Total	786	

Table 4-26. Transition in aircraft (Table V)

TASK	MODE	ROUNDS	TARGET	RANGE (METERS)	TARGET EFFECTIVENESS
1-1	Hover	30	Troops	150 to 500	50% or target hit
1-2	Moving	30	Troops	500 to 800	50% or target hit
1-3	Hover	30	Recon vehicle	500 to 800	50% or target hit
1-4	Moving	30	Recon vehicle	800 to 1,000	50% or target hit
1-5	Hover	30	Troops/ vehicle	500 to 1,000	50% or target hit
	Total	150			

NOTE: Target area is 100 by 100 meters.

(2) Stated in its simplest terms, the gun must be aimed correctly the instant it is fired; that is, it must be pointed so that the projectile will hit the target. Aiming a stationary gun at a stationary target in a force-free field would require simply pointing the gun at the target. However, firing never occurs in a force-free field. A door gunner's weapon is seldom stationary, and his target is even less so.

(3) All the factors that determine the amount of target compensation are estimated by the gunner. He leads the target by what seems to be the correct amount and makes adjustments by trial and error. The factors that affect the door gunner's accuracy are identical to those ballistic factors for weapons fired in the flexible mode.

b. Gravity exerts a constant force which pulls the projectile toward the earth (gravity drop). Air resistance tends to decrease the initial velocity of the projectile (drag). Moving air tends to deflect the projectile from its predetermined trajectory (wind drift). A certain amount of deflection is inherent in the gun. This is caused by the spin that is imparted to the projectile (projectile drift). A projectile tends to deflect in the direction in which the aircraft is moving when the weapon is fired (trajectory shift). When the gunner fires from the left side of the aircraft, the deflection caused by shift and drift is to the right. When the gunner fires from the right side of the aircraft, shift and drift are in opposite directions and tend to cancel each other (port-starboard effect).

(1) When the gunner fires from a moving helicopter, a crosswind component will cause a deflection of the projectile. When the gunner fires from the right, the crosswind will be from the left and will cause the projectile to deflect slightly downward. When the gunner fires from the left, the crosswind will be from the right and will cause the projectile to deflect slightly upward (projectile jump).

(2) The extent of effect for all these factors depends on the distance the projectile must travel. Target range becomes extremely important. When the target is moving, an additional compensation must be made because the target will change position during the projectile's time of flight. To hit the target, the gunner must aim not at the target but at the point in space where the target will be when the projectile arrives.

4-16. FIRING TECHNIQUES

a. The door gunner and his instructor must realize that aerial firing and sighting are complex problems involving speeds, ranges, firing angles, and ballistics. Examples of the door gunner's situation are contrasted to the ground gunner's as follows:

(1) The door gunner's firing platform is always moving. The ground gunner usually fires from a stationary platform.

(2) The door gunner has a difficult problem with range. The ground gunner can use range finders, maps, or known ground reference points to determine range more easily.

(3) The door gunner is mainly on his own regarding fire control and conservation of ammunition. The ground gunner receives his fire control instructions from his section leader.

(4) The door gunner must act in a split second. He does not have the time that the ground gunner has to compute his aim carefully.

b. Range estimation is the first step that the door gunner takes in preparing to shoot at a target. Door gunners should practice range estimation throughout their training. For range estimation to be of any value under combat conditions, gunners must be able to recognize ranges instantly and accurately. The time it takes the projectile to reach

the target will determine how much the projectile will be affected by all the ballistic factors previously discussed.

(1) The following two simple rules apply when engaging targets from a moving helicopter:

- Rule 1—When firing from the right side of the helicopter, the gunner should aim high and to the near side of the target.
- Rule 2—When firing from the left side of the helicopter, the gunner should aim low and to the near side of the target.

(2) In both rules, the aiming point is to the near side of the target because the motion of the aircraft and the effects of projectile drift will carry the bullet forward. The amount of forward movement is greater on the left side than on the right side because of port-starboard effect. The difference between aiming high or low is caused by the effects of projectile jump (Figure 4-11).

4-17. SIGHT PICTURES

a. The M60D machine gun has a front blade sight and a rear ring sight. Placing the horizontal cross hair of the rear ring sight and the top of the front blade sight on line with the aiming point will compensate for the effects of gravity drop at ranges up to 750 meters. The gunner must aim higher at

ranges beyond 750 meters by placing the sight picture above the target.

b. To lead the target properly, the gunner must align the target and front blade sight with an appropriate point on the horizontal cross hairs. Target alignment depends on aircraft speed, the side from which the gunner will be firing, and the firing angle. As the gunner's ability to estimate lead angle improves, more accurate and immediate fire may be achieved. He can directly align the rear and front sights and displace the sight picture either left or right of the target (see Figure 4-12). This is the preferred method of attaining a sight picture.

4-18. FIRE ADJUSTMENT

The door gunner adjusts his fire by observing either bullet impact or tracer trajectory. The standard 4-to-1 ratio of linked ammunition (four rounds of ball to one round of tracer) will provide a sufficient number of tracers for effective fire adjustment. For training purposes, however, firing a solid tracer greatly assists the door gunner in learning. Adjusting fire by using tracers has a drawback. This disadvantage occurs primarily at longer ranges. Observer shift becomes more pronounced at higher airspeeds. There are two versions of observer shift: the one that occurs before tracer burnout and the one that occurs after tracer burnout.

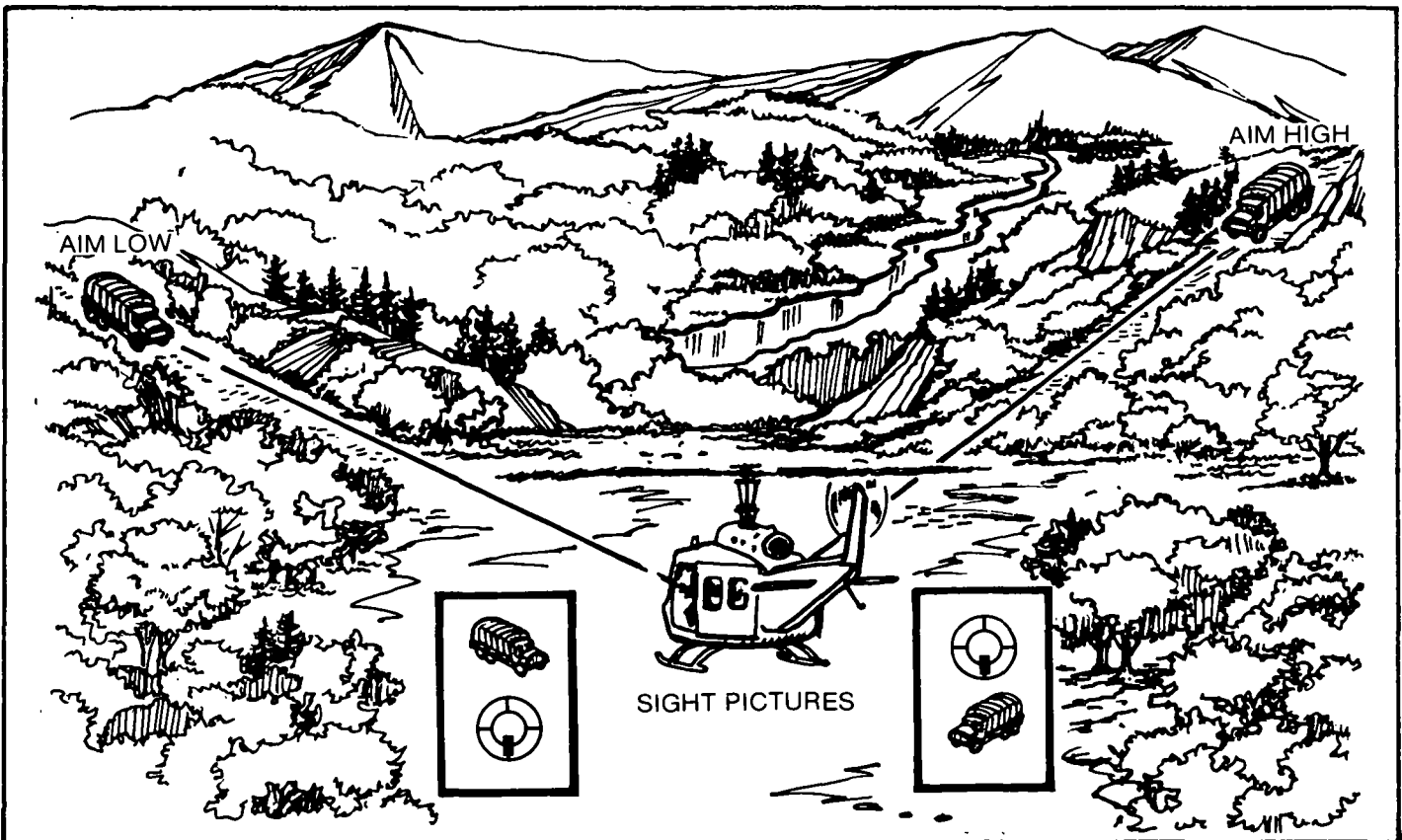
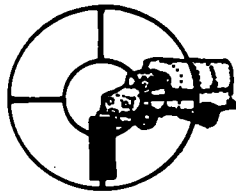
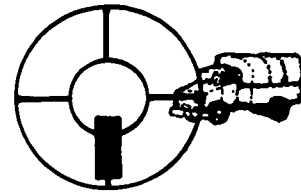


Figure 4-11. Aiming points

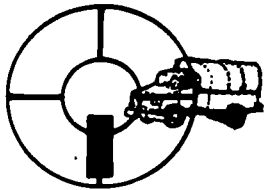
SLOW AIRSPEED (25 KNOTS)
TARGET AT 11 O'CLOCK OR 7 O'CLOCK



HIGH AIRSPEED (100 KNOTS)
TARGET AT 11 O'CLOCK OR 5 O'CLOCK



25 KNOTS
TARGET AT 9 O'CLOCK



100 KNOTS
TARGET AT 9 O'CLOCK

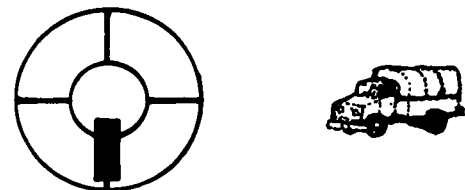


Figure 4-12. Sight pictures

a. In Figure 4-13, the gunner fires at a target from position A but has aimed slightly high. The projectile then travels directly over the target and impacts behind it. By the time the round impacts, the gunner has moved along the flight path to

position B while constantly watching the tracer trajectory. Because of his change in position, he is led to believe that he has aimed not only high but also to the left.

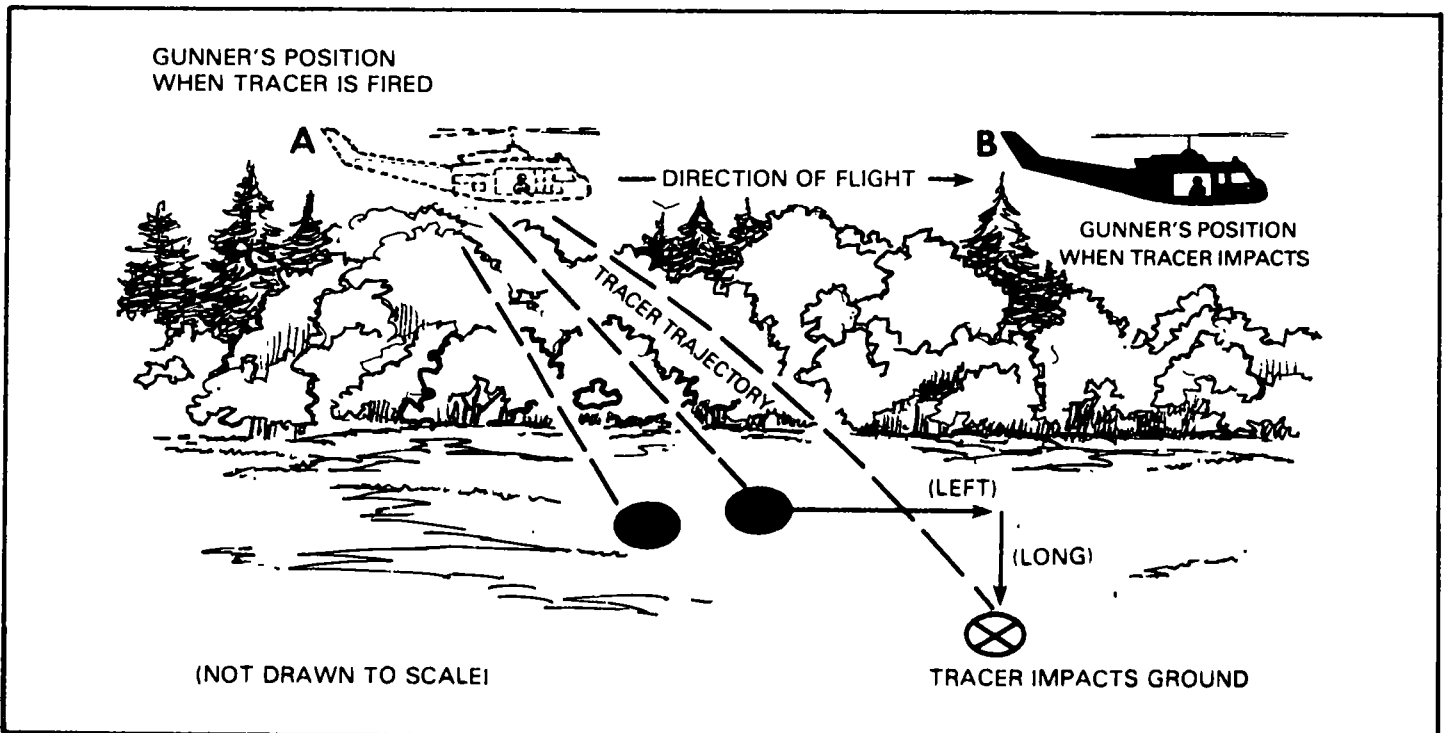


Figure 4-13. Observer shift before tracer burnout

b. Observer shift is also deceptive when the gunner is firing at a target that is beyond tracer burnout. In Figure 4-14, the gunner fires at a target from position A. As the tracer travels toward the target, the gunner's helicopter has traveled to position B along its flight path. When the tracer

disappears, the gunner concludes (incorrectly) that he has aimed low and to the right. In reality, the bullet continued along its trajectory and struck the target. The solution to observer shift is awareness and training.

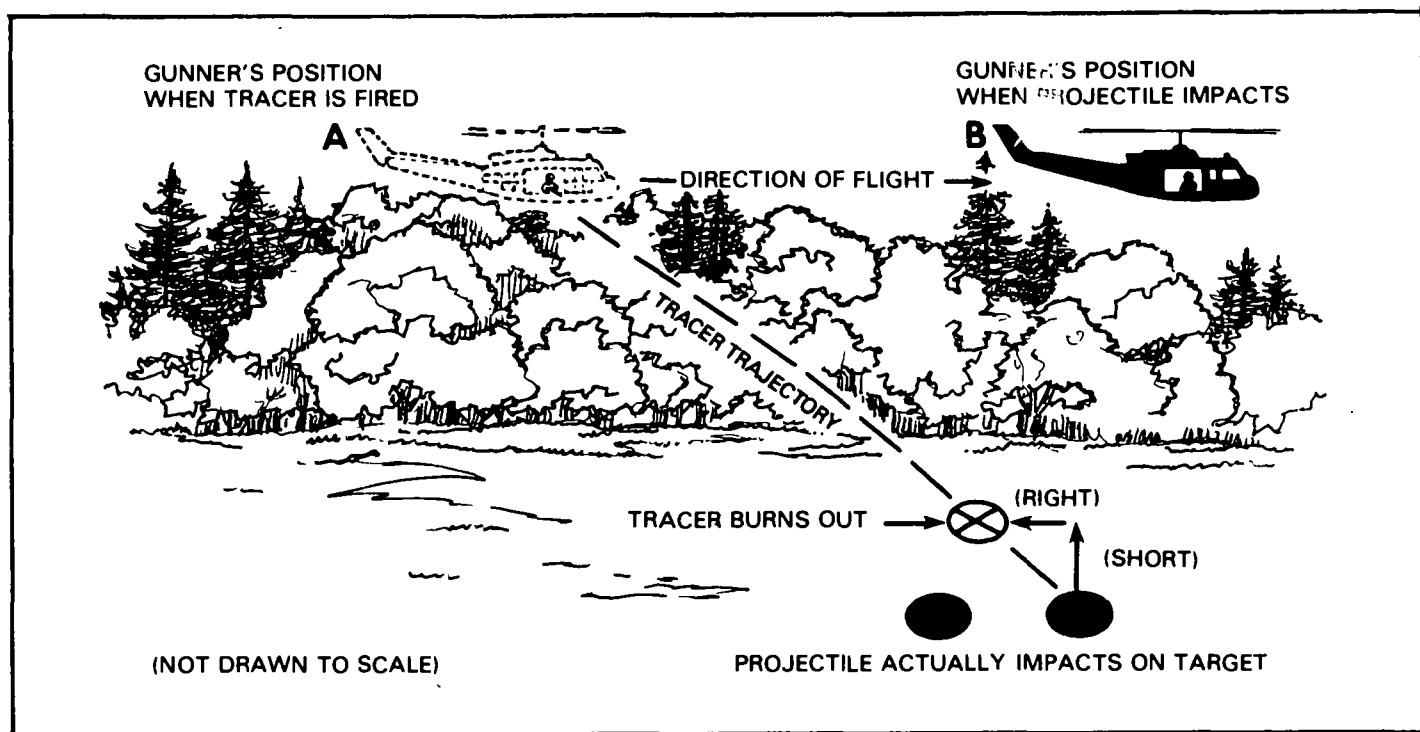


Figure 4-14. Observer shift after tracer burnout

CHAPTER 5

RANGES

This chapter presents typical administrative and logistical requirements for range firing. It also presents a sample gunnery range that allows simultaneous use by various weapons around the periphery of the range impact area. For information on range operations see ARs 385-62, 385-63, and 385-64.

Section I

RANGE REQUIREMENTS

5-1. RANGE CONSIDERATIONS

a. Proper preparation is necessary for effective aerial gunnery firing since most units have limited range time and facilities. This includes normal preparations for field training, such as mess and individual equipment. It also includes the basics of attack helicopter firing, such as aircraft, weapons, range facilities, and ammunition. Limited range availability and a lack of adequate planning and preparation result in a loss of valuable training time.

b. Because range time and range availability are limited, maneuver areas for dry firing do not have to be near the firing ranges. Units can conduct dry-fire crew and team or section training before coming to the firing range.

c. Realistic training, to include such tasks as team fire and maneuver and hot refueling, is essential in developing a unit that is highly effective. Because of inherent dangers, proper safety measures must be an integral part of the training program.

d. Personnel involved in helicopter range operation must continuously monitor all aspects of range operation and report unsafe conditions to the officer in charge. Proper loading, boresighting, stoppage clearance, and range firing procedures must be followed. Other safety precautions prescribed in this chapter and contained in applicable references must also be followed.

e. Effective range administration and operation are crucial to any firing exercise. The company or troop commander must have a thorough knowledge of how to organize and operate a gunnery range efficiently.

f. Aerial gunnery training uses live ammunition to achieve a realistic training situation. Each unit should develop a range firing and safety SOP applicable to its special situation. Range safety includes flight safety, ground safety, and firing safety.

5-2. REALISTIC TRAINING

a. Existing ranges that do not meet aerial gunnery requirements are inherent problems at many installations. A multitude of scenarios may be produced to reflect the unit's mission and to gain maximum usage of available range facilities. Scenarios—such as fire and maneuver, route reconnaissance, or relief on station—may be produced to fit a unit's mission or conform to range restrictions.

b. A firing and navigation course can be set up with firing positions on ranges. The scout navigates and directs the attack helicopter along the NOE navigation and firing course into a firing position or range. There, the scout hands over the target to the attack aircraft. The attack aircraft will orient on the target heading, unmask, acquire the target, and engage the target.

c. To set up these firing positions, draw outlines of the required surface danger area, as described in AR 385-63, on overlay paper. Cut the outlines out, lay them on each position, and set up the range.

d. Physical control measures can add safety but, for a realistic and challenging course, should be kept to a minimum. If the control aircraft verifies that the firing aircraft is located in a firing position and oriented in the target direction, then the aircraft is safe to fire.

e. The final step is the most important for realistic training. With the tables in Chapter 4, the target array and scenario for the course can be designed. Use of the scout on every engagement provides realistic training and better understanding between the scout and attack aircraft. The target handover and fire command provide the information required for a realistic attack. These also serve as the best safety control measures.

(1) Firing tables fulfill minimum training requirements. Safety regulations fulfill minimum safety requirements. The trainer's imagination, ingenuity, and tactical experience are an integral part of a successful training program.

(2) Sample range layouts are provided in this chapter. NOE hover fire routes can be established around the impact area. These routes may also be used as a target identification range. With a firing point and an appropriate target array, these sample range layouts identify a variety of threat silhouettes. Warsaw Pact hard targets are presently not available; US-made armor vehicle hulls with a plywood silhouette are good simulated targets. The target array formed of NATO and Warsaw Pact targets assists the crew in target identification and detection.

(3) Targets to be engaged from the various firing points should vary in range and type. These type targets facilitate training the crew in weapon and ammunition characteristics and ballistics. Silhouettes should be constructed to full size, when possible, to provide accurate hit-miss probability data and to conserve training ammunition. Targets must have a thermal signature when used in night-firing exercises by attack helicopters with thermal sights/target acquisition systems and devices. Hard targets should be artificially heated. Plywood silhouettes mounted on target lifters should have the standard Army thermal signature devices.

5-3. FACILITIES REQUIREMENTS

a. Preplanning. A list of range facilities requirements includes all of the permanent and semipermanent fixtures needed in the range areas. To avoid last-minute problems, early planning is essential. Normally, six months lead time is desirable. Planning considerations must include—

- Requested range availability.
- Alternative emergency airstrips.
- Arming points.
- Ammunition storage areas.
- Control point (high ground).
- Target arrays (stationary, moving, and laser).
- Boresight pads/targets.
- Emergency weapon safing areas.

- Latrines.
- Mess areas.
- Billeting areas.
- Maintenance areas.
- Refueling points.
- Jettison areas.
- Training objectives.
- Movement routes (armed and prearming).
- Instrumentation.
- Detail manpower.
- Communications.
- Ammunition available.
- Combined arms integration.
- Target device availability.

b. Construction. Some facilities may be constructed by engineers; some may be prepared or improved by the unit. For example, a hill or high terrain area improved by the unit may serve as a control tower. The list of facilities can be easily expanded; maximum detail is desirable.

5-4. EQUIPMENT REQUIREMENTS

a. Preparation. Weapons and aircraft due maintenance inspections may not be available for training. Therefore, equipment requirements also must be considered during the planning and preparation stage. The trainer must consider—

- Firing aircraft.
- Scouts.
- Command and control aircraft.
- Weapons.
- POL.
- Crash and rescue equipment.
- Medical evacuation equipment and MEDEVAC.
- FM radios.
- Illumination equipment for night firing.
- Wheeled vehicles.
- Portable hydraulic supply.
- Tents.
- Generators.
- Personal equipment.
- Ammunition ordered. Training practice ammunition for pop-up or moving targets should be emphasized.
- Mess equipment.
- Administrative briefing.
- Binoculars.

b. Adaptation. This list may be expanded; units in different environments have different requirements. Some equipment must come from outside unit resources. Plan early to avoid problems.

5-5. PERSONNEL REQUIREMENTS

a. Initial Requirements. Fulfilling personnel requirements is as important as fulfilling facilities and equipment requirements. The gunnery training program must be integrated into the unit training calendar to coordinate unit efforts. Some specialized personnel who will require extra preparation are the—

- Range OICs.
- Safety officers (range and laser).
- Range control officers.
- Evaluators/scorers.
- Medical personnel.

- Crash and rescue teams.
- Air traffic controllers.
- Armament personnel.
- POL personnel.
- Maintenance personnel.

b. Continuity Training. The positions listed above are critical to the unit's ability to perform the range mission. Safety officers must be prepared for their duties on the ranges. They should also be preparing others in the unit for safe range operations during the pregunnery training program. Crash and rescue teams may come from outside the unit. They may also be trained by the unit. To be certain of efficiency and safety, armament personnel require refresher training before the actual firing period. Other personnel mentioned also require refresher training before the actual firing period. The unit personnel status should be examined for other areas of concern.

Section II

PERSONNEL RESPONSIBILITIES AND DUTIES

5-6. OFFICER IN CHARGE

A live-fire range may not be operated without the OIC. The OIC supervises range personnel and enforces range safety. Officers in charge must be qualified and certified under AR 385-63, Chapter 4. If the OIC is airborne during training, he must maintain radio communication with the RCO. Range OIC requirements are shown in Table 5-1.

a. Before firing, the OIC—

- Obtains present and forecasted weather reports.
- Obtains a range briefing from the post range officer. This is required by current local range regulations.
- Contacts range headquarters for clearance to fire; records time and name of person giving clearance and time.
- Ensures that medical aidmen, ambulance, and ambulance driver are present, range flag is up, and range sweep completed.
- Verifies that required personnel and equipment are present.
- Verifies ammunition loading by type and amount with senior armorer.
- Prescribes altitude and routes to the range.

b. During firing, the OIC—

- Maintains positive radio control of all helicopters on range.

- Supervises flight operations and safety procedures.
- Observes all range activities from control point to ensure safety and efficiency.
- Reports to visitors and inspecting officers as the helicopter control situation permits.
- Observes and spot-checks ground operation.

c. After firing, the OIC—

- Verifies that the range is closed and completes reports as required.
- Ensures that the flag is removed, buildings and tower are secure, and all operating areas are policed.
- Debriefs as necessary.
- Releases armament, medical, and maintenance personnel when firing is completed and the last helicopter is airborne.
- Supervises completion of reports.

5-7. RANGE SAFETY OFFICER

The RSO ensures safe operation of the range. He is familiar with the range SOP and the aircraft and armament emergency plan. He is also aware of proper storing, handling, and loading of ammunition and fuel and knows the duties of all range personnel. RSO prerequisites are contained in AR 385-63. The RSO—

- Observes all aspects of range operation continuously and reports unsafe conditions to the OIC.

Table 5-1. Range OIC requirements

PERSONNEL

- | | |
|--|---|
| ☐ RANGE CONTROL OFFICER | ☐ NCO IN CHARGE OF AMMUNITION |
| ☐ RANGE SAFETY OFFICER | ☐ AMMUNITION PERSONNEL |
| ☐ MEDICAL AIDMEN | ☐ MESS PERSONNEL |
| ☐ AMBULANCE DRIVER | ☐ REFUEL TEAM |
| ☐ INSTRUCTORS/EVALUATORS/
UNIT TRAINERS/SCORERS (AS
REQUIRED) | ☐ MAINTENANCE AND SUPPORT
PERSONNEL |
| ☐ COMMUNICATIONS PERSONNEL | ☐ REPORTING NCO OR OFFICER |
| ☐ ARMORERS | ☐ RANGE CLEAN-UP DETAIL |
| | ☐ ROAD GUARDS |

EQUIPMENT

- | | |
|---|---|
| ☐ RANGE FLAG | ☐ FUEL TRUCKS |
| ☐ RANGE CARDS | ☐ WATER POINT |
| ☐ COMMUNICATIONS EQUIPMENT | ☐ MESS FACILITY |
| ☐ RANGE REGULATIONS AND SOP | ☐ FLASHLIGHT WITH BATTERIES |
| ☐ WARMING TENT | ☐ DEBRIEFING TENT |
| ☐ SCORESHEETS | ☐ CHALKBOARD WITH CHALK |
| ☐ PENCILS | ☐ TOOL KITS |
| ☐ TRASH CANS | ☐ CONTROL AIRCRAFT |
| ☐ LATRINE SUPPLIES | ☐ TARGET ILLUMINATION |
| ☐ AMBULANCE | ☐ RED LENS LANTERN WITH
BATTERIES |
| ☐ STOPWATCHES | ☐ TARGET HEATERS (NIGHT) |
| ☐ FIRE FIGHTING EQUIPMENT
OR FIRE TRUCK | ☐ BEAN BAG LIGHTS |

COORDINATION

- | | |
|---|--|
| ☐ RANGE CONTROL | ☐ MEDICAL PLATOON |
| ☐ S3 (HIGHER) | ☐ POST AMMO DUMP |
| ☐ S4 | ☐ GROUND UNIT STAFF |
| ☐ SERVICE PLATOON LEADER | ☐ MILITARY POLICE |
| ☐ MESS HALL | ☐ EXPLOSIVE ORDNANCE DISPOSAL |

- Conducts the safety portion of the range briefing as specified in the local lesson plan.
- Briefs the senior armorer.
- Determines deficiencies of personnel and equipment.
- Inspects the firing line, parking and ammunition loading areas, and the area of the range visible from the control point for safety hazards.
- Ensures vehicles, equipment, and aircraft are properly positioned.
- Prescribes vehicle parking area and organization and operation of crew to service attack helicopters.
- Briefs the NCOIC of the ammunition detail.
- Determines the ammunition count and any equipment deficiencies.
- Checks the organization and operation of the ammunition detail.
- Briefs refueling personnel on helicopter refueling and vehicle parking areas and range safety.
- Observes safety procedures during fire.
- Observes safety procedures during ground operation.
- Inspects crash and rescue equipment and reports any deficiencies in equipment or training of personnel.
- Ensures that a preaccident plan is in effect and all concerned personnel are aware of the plan.
- Observes the safety procedures of the armorer crew and determines any deficiencies of equipment or personnel.
- Observes safety procedures of POL personnel and checks for any deficiencies in equipment or personnel.
- Ensures that all POL personnel use proper procedures in refueling aircraft and vehicles.

- Ensures that no foreign objects are present in the parking area or on the flight line.
- Ensures that the RCO has a copy of the preaccident plan.
- Ensures that knowledgeable EOD personnel are available.
- Ensures a diagram that shows location of all range facilities, range fan information and flight routes, minimum altitudes, other impact areas, low-level hazards to flight, and possible caution areas is displayed at the central control point.
- Establishes access routes to helicopter operating areas.
- Establishes procedures for notification and dispatch of emergency crew (by RCO or radio operator/controller only).
- Implements the following safety precautions, as required:
 - ☐ Approach the attack helicopter from the side only, while staying clear of rotors' and subsystems' flexible limits of movement.
 - ☐ Inspect each weapon subsystem for safety before loading for firing.
 - ☐ Allow no smoking within 50 feet of helicopters or ammunition.
 - ☐ Use protective devices (such as earplugs and dust goggles).
 - ☐ Use containers for collection of ammunition and brass.
 - ☐ Ensure safe handling and cleanliness of ammunition.
 - ☐ Control loose rounds.

5-8. INSTRUCTOR PILOT/UNIT TRAINER

The IP/UT is familiar with the unit range SOP, aircraft and armament emergency procedures, and the local accident report form. He is qualified and current in weapon subsystems in accordance with the ATM. The IP/UT ensures that assigned helicopter and weapon subsystems operate using the following prescribed procedures and applicable safety precautions. He is familiar with the azimuth, range, and sector azimuth limits of the range. He directs the positioning of armament subsystem switches. The IP/UT also directs training as prescribed in the local lesson plan. The IP/UT—

- Observes all aspects of range operation continuously and reports unsafe conditions to the OIC, RCO, or RSO.
- Ensures safe operation of the helicopter and weapon subsystems.

- Ensures that firing is conducted only when the helicopter is on course and all weapons are aimed at the target.
- Performs all required radio reports.
- Ensures that all live ammunition is cleared from the helicopter at the conclusion of the firing period.
- Completes reports and evaluations as required.

NOTE: The UT may substitute when the IP is not available. Only an IP or SIP can evaluate a nonqualified person. The PIC is authorized to conduct the above duties when both aircrew members are qualified and current in the helicopter.

5-9. RANGE CONTROL OFFICER

The RCO works for the OIC as an assistant. When the RCO cannot control firing from the ground, the airborne OIC or his designated representative is responsible for range safety. The RCO—

- Controls firing on the range.
 - Ensures safe operation of the range.
 - Maintains a thorough knowledge of the range SOP and the aircraft and armament emergency (preaccident) plan.
- a. Before firing, the RCO must—*
- Obtain a range briefing from the post range officer as required by local range regulations.
 - Inspect firing line area, parking areas, and ammunition loading areas.
 - Inspect the range area visible from the control point for safety hazards and to ensure that vehicles, helicopters, and equipment are properly positioned.
 - Ensure the range flag is emplaced.
 - Contact range headquarters for clearance to fire.
 - Ensure medical aidmen are present and range sweep conducted as required.
- b. During firing, the RCO must—*
- Maintain radio control of all helicopters operating on the range.
 - Observe all visible range activities.
 - Report to official visitors and inspecting officers, as necessary.
 - Maintain a record of ammunition expended at the completion of each day's firing.
- c. After firing, the RCO must—*
- Close range with range headquarters.
 - Inspect range area to ensure that the range flag has been removed, all structures have been secured, and operating areas have been policed.

- Release armament detail, medical aidmen, and maintenance personnel when the last aircraft has departed the range.

5-10. LASER RANGE SAFETY OFFICER/NCO

For all laser range operations, unit commanders must designate, train, and certify LRSOs or LRSNCOs as safety officers. The LRSO or LRSNCO will—

- Be familiar with AR 385-63, Chapter 19, and the FM and TM applicable to the particular laser devices to be used.
- Brief unit personnel who work with laser devices on laser-related hazards and safety devices.
- Know the range fans, including elevations, firing position, and target to be used.
- Ensure protective eyewear is used, when required.
- Ensure compliance with unit SOP regarding laser operations and training.
- Maintain continuous communications with personnel in the target area and stop lasing immediately if communications are lost.
- Stop lasing immediately if positive control of the laser beam is lost.

5-11. RADIO OPERATOR/CONTROLLER

The radio operator/controller ensures that radios are working properly. He is familiar with the range SOP and aircraft and armament emergency (preaccident) plan. He assists the RCO as directed. The radio operator/controller—

- Reviews the range SOP.
- Installs the range flag.
- Opens the range upon order of the RCO.
- Assists the RCO with traffic control by following the range SOP.
- Closes the range upon order of the RCO.
- Turns off and secures all radios.
- Removes the range flag.

5-12. SENIOR ARMORER

The senior armorer directs the control and proper use of enlisted personnel on the ground. He ensures that proper equipment and required personnel are at the range to conduct firing and give ground support. He also ensures that the proper amount and type of ammunition is on hand for range firing.

a. Before firing, the senior armorer—

- Checks personnel and equipment.
- Obtains helicopter tail numbers and verifies that ammunition loading is correct.

- Assigns duties to the crew (armorers to helicopter and driver to vehicle).
- Remains at duty position until directed otherwise by the OIC or the NCOIC.
- Visually inspects the range area on and behind the firing line for safety.
- Briefs the crew on the location of the helicopter and vehicle parking areas, the type of firing table, and the ammunition load.
- Reviews the following safety precautions as required:
 - ☐ Approach and depart the vicinity of the helicopter from the side and only after visual recognition from the pilot in the helicopter.
 - ☐ The last man to leave the helicopter's vicinity will give an "all clear" signal to the pilot.
 - ☐ Ensure personnel remain clear of loaded subsystem danger areas at all times.
 - ☐ Secure the subsystem before anyone enters or leaves the helicopter or as directed by the pilot.
 - ☐ Remain clear of subsystem areas during boresighting.
 - ☐ Check the subsystem only when the arming switch is in the SAFE position as directed in the appropriate technical manual.
 - ☐ Check proper installation of safety bridges.
 - ☐ Allow no smoking within 50 feet of ammunition or helicopter.
 - ☐ Use available protective devices, such as ear protectors.
 - ☐ Secure loose equipment in the helicopter.
- b.* During firing, the senior armorer—
 - Supervises all armament crew activities for operation.
 - Supervises all armament crew activities for safety.
- c.* After firing, the senior armorer—
 - Polices the firing line, separating live rounds and expended brass in a specified container for turn-in to ammunition area.
 - Polices range areas behind the firing line (parking areas and tower vicinity).
 - Checks security of buildings and equipment on the range and in the classroom or briefing area.

5-13. AMMUNITION IDENTIFICATION

The ammunition NCOIC will conduct classes to educate ammunition, armorer, and flight crew personnel in identification and proper loading of ammunition. These classes will be accomplished before and during range operations. The senior gunnery IP may substitute for the ammunition

NCO. Additional information on ammunition can be found in TM 9-1300-200.

5-14. LOGISTICAL REQUIREMENTS

Advanced forecasting and budgeting are required to ensure logistical support is available during the desired training period. For example, advanced planning and preparation are required to ensure adequate POL, ammunition, armament repair parts, and range facilities are available. Extensive planning will be required to coordinate unit

participation in team combined arms training. An effective range requires a great deal of support. The OIC, through the service platoon leader, should coordinate most logistical support functions. These functions include medical support, mess support, and ammunition. These support activities also include aircraft and weapon systems maintenance, transportation, and supply (including targets). All logistical support requests should be communicated to the service platoon leader as soon as possible.

Section III

AERIAL GUNNERY RANGE SAFETY

5-15. GROUND SAFETY

Ground support personnel must be constantly aware of the dangers involved in live-fire training. Support personnel must be trained in the care and handling of ammunition and in loading and unloading procedures for each weapon subsystem. They must also be trained in the procedures for firing each weapon subsystem and procedures for working near operating helicopters. Loading areas should be separate from refueling areas. In addition, support personnel should be drilled on emergency situations as related to their duties. The rules for ground safety are—

- Personnel must avoid main and tail rotors, turret weapon systems, and wing store fore and aft blast areas during aircraft operation.
- Personnel will approach the helicopter from the 90-degree side position only after receiving visual recognition from the aircrew.
- Personnel will exercise caution when walking under the main rotor arc or around the tail rotor.
- The helicopter will not be moved until an armorer moves out of the main rotor arc at the 90-degree side position and signals “all clear.”
- Before departing the arming or disarming area for the home station, support personnel will remove all ammunition from the helicopter.
- One crew member will visually check to ensure all weapons are cleared.
- The helicopter must be grounded before any maintenance is performed and before the aircrew enters or exits the helicopter.
- All personnel working on or near the helicopter will have their sleeves rolled down.
- All personnel will use proper hearing protection devices.
- During night operations, ground personnel will carry a flashlight or wear a head lantern when working near the helicopter.

- To maintain communications between the aircrew and armorers servicing the armament subsystems, common hand signals must be used (see Figure 5-1).

5-16. FIRING SAFETY

Range safety requirements for firing aerial weapons are contained in AR 385-62 and AR 385-63. For safety requirements for each system, see the applicable TM 55-1520-series -10 manuals.

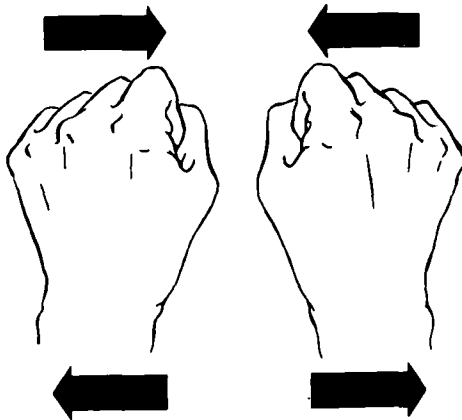
a. In addition to inspecting individual weapons, firing safety also includes ensuring that—

- Clearance is received from the controller before unsafing weapons.
- Weapons are pointed downrange and within range fan limits.
- Ground personnel are not in front of the weapons or in the backblast area.
- No other aircraft are within the surface danger area.
- Weapons are not fired closer than the minimum safe slant range.
- Laser range finders and target designators are considered and controlled as weapons.

b. The rules for firing safety are—

- During range operations, armament subsystems will be pointed downrange or away from populated areas, whenever possible.
- Armament subsystems are considered safe for range traffic pattern operations under safe or standby conditions.
- Armament subsystems may be placed in the ARM position if the helicopter is pointed downrange at the firing point and no other aircraft are in the range danger zone. (Laterally parked helicopters may be cleared for formation firing and team training.)
- Operating and positioning the arming switch is the IP's or SIP's responsibility.

MOVE HANDS TOGETHER: ARM SYSTEM (LOAD AMMUNITION)

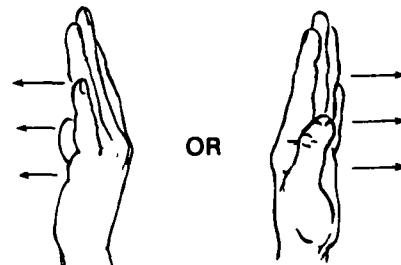


OK: WEAPONS SIGHTED CORRECTLY,
CONDITION CORRECTED

MOVE HANDS APART: DISARM SYSTEM (UNLOAD AMMUNITION)

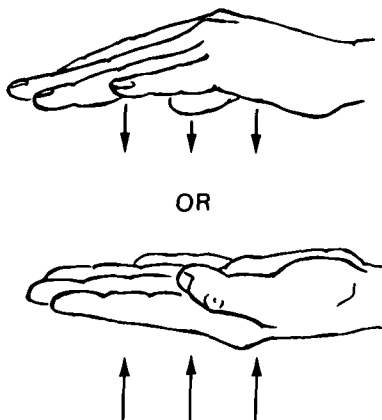


READY TO FIRE: CLEAR AND READY TO FIRE,
INDICATED BY POINTING DOWNRANGE



AZIMUTH ADJUSTMENT: HAND UP, PALM TOWARD
DIRECTION OF ADJUSTMENT DESIRED

MAGNITUDE OF MOVEMENT INDICATES RELATIVE
AMOUNT OF ADJUSTMENT REQUIRED



ELEVATION ADJUSTMENT: HAND OUT,
PALM UP OR DOWN TO INDICATE
ADJUSTMENT DESIRED



DEPRESS ACTION SWITCH

Figure 5-1. Ground hand signals

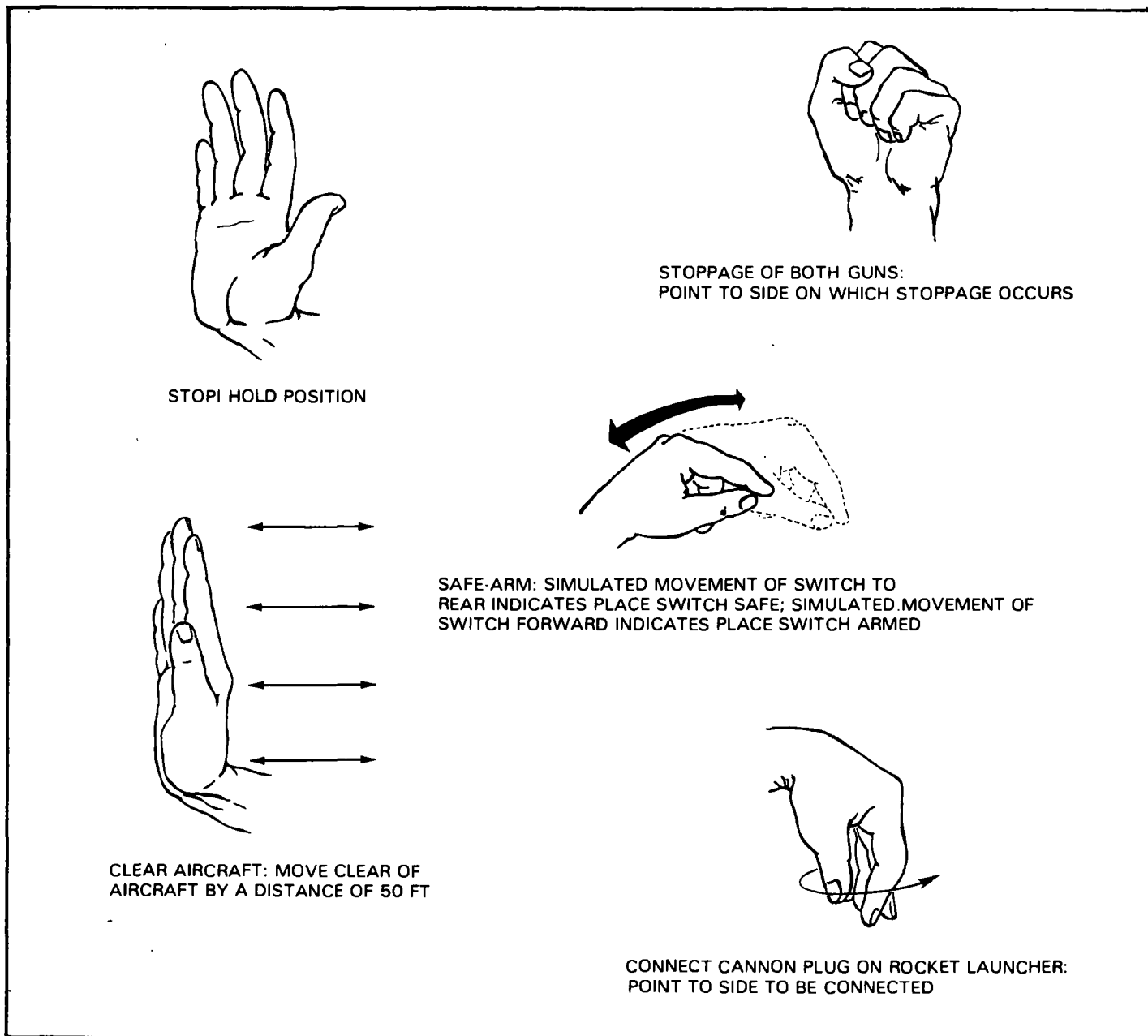


Figure 5-1. Ground hand signals (continued)

NOTE 1. A safe or standby condition does not include pulling circuit breakers on the weapon systems. If circuit breakers on weapon systems are pulled, the systems are no longer grounded. Therefore, the circuit breakers should be left in; however, all arming switches should be turned off. Refer to the appropriate technical manual for correct safing procedures for each weapon system.

NOTE 2. When conducting NOE hover fire, the armament system is not armed until the helicopter arrives at the firing position.

5-17. AIRCRAFT EMERGENCY PLAN

The aircraft emergency plan prescribes the procedures followed in an aircraft emergency (accident, incident, or inadvertent firing) during range firing. The aircraft emergency plan should provide for immediate accident notification to the OIC and RSO. The plan will be initiated upon receipt of this notification. Each major installation commander is responsible for providing his installation with an aircraft preaccident plan. The range OIC will ensure that mishaps are reported in accordance with local policies.

Section IV

RANGE LAYOUT

5-18. CONSIDERATIONS

When practical, firing lanes should be constructed using existing terrain and vegetation. To preserve realistic conditions, keep vegetation clearing to a minimum. To facilitate boresighting and emergency situations, ensure that the first 500 meters of a firing lane are clear and its terrain relatively flat.

5-19. MARKERS

The start-fire line must be clearly marked and visible from the air. For control purposes, it is also desirable that the start-fire line be visible from the control point. Landing pads on the firing line should be clearly marked for both day and night landings.

5-20. TARGETS

To provide the widest latitude in training, the nature and arrangement of targets should be varied. Automated scoring and feedback targetry should be used when available. Targets should be positioned to permit laser engagements where possible.

5-21. MULTIPURPOSE RANGE COMPLEX

Figures 5-2, 5-3, 5-4, and 5-5 depict representative combined arms ranges which can accommodate helicopter gunnery. Currently, 18 MPRCs are being

constructed worldwide. These ranges are fully automated and instrumented. They use state-of-the-art targets and controlling devices. MPRCs are designed for combined arms gunnery and aircraft. MPRCs provide the most realistic training conditions available. Commanders should plan their gunnery programs to integrate helicopter gunnery into combined arms exercises.

a. The MPRC consists of an area approximately 3,000 meters by 5,000 meters. It employs RETS, stationary, and moving targets.

b. The MPRC will contain enough targets to satisfy training requirements. These training requirements are shown in the Bradley fighting vehicle, tank, and attack helicopter gunnery manuals.

c. The MPRC can support multiple levels of training. Because of the variety of weapons training that can be conducted on the range simultaneously, individual, crew, team, and combined arms training is possible.

d. Using live fire, nondud-producing ammunition and MILES/AGES laser engagements, the MPRC can support training as outlined in AR 350-1, in FM 25-1, and in this publication. Figure 5-5 represents a two-lane MPRC layout.

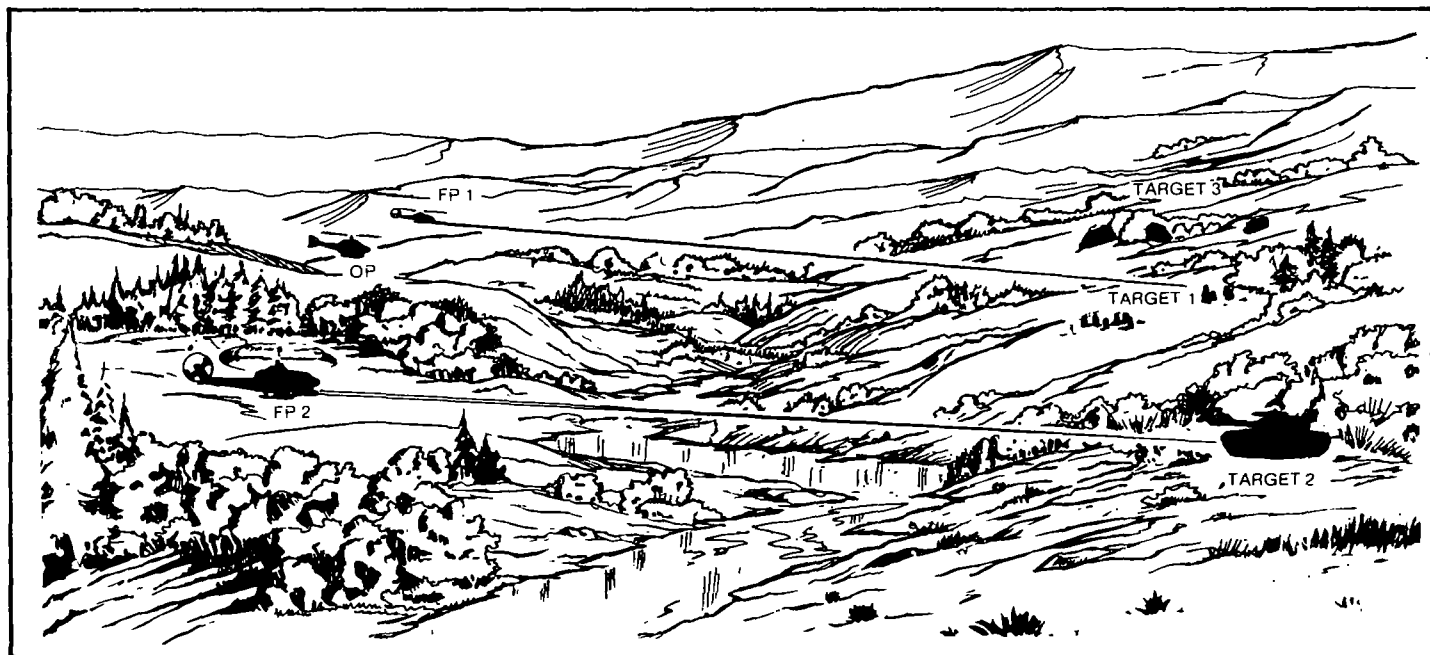


Figure 5-2. Panoramic view of range layout

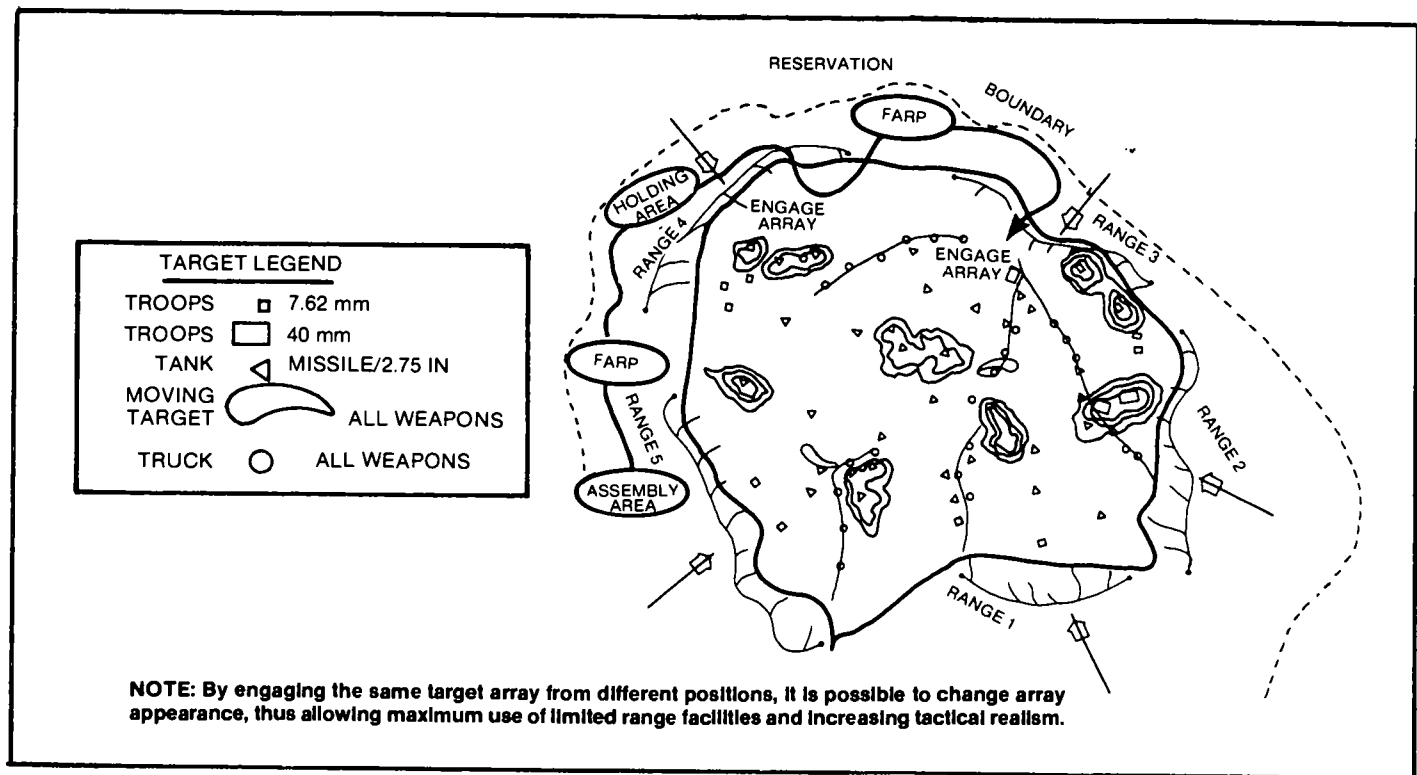


Figure 5-3. Installation helicopter gunnery range layout

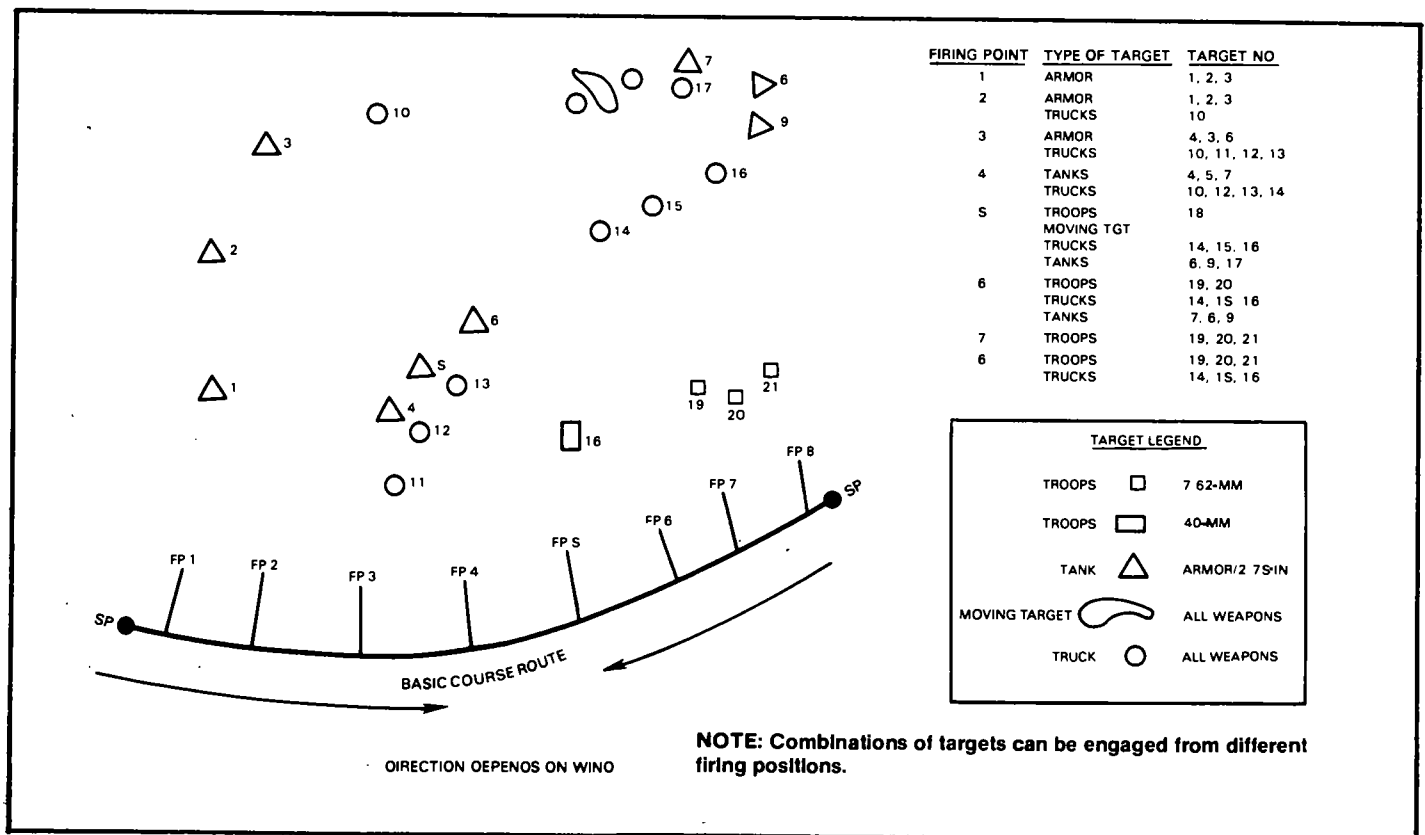


Figure 5-4. Close view of a single gunnery range layout

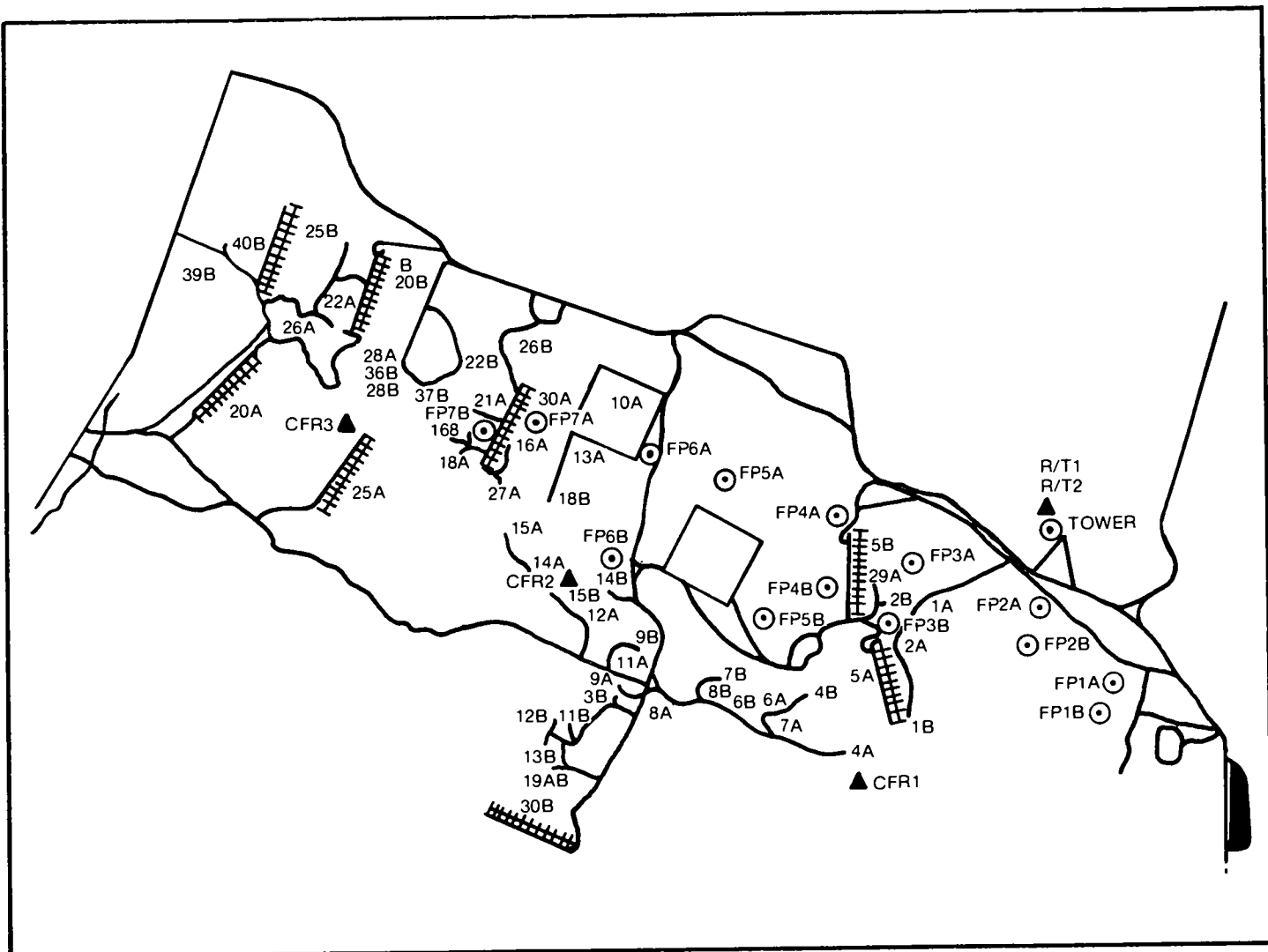


Figure 5-5. Two-lane MPRC layout

CHARACTERISTICS OF AERIAL WEAPON SYSTEMS

Aerial weapon systems are becoming more sophisticated with the integration of the AH-64 and AH-1S(MC) weapon platforms. This appendix briefly describes present and future weapon systems which will be employed by Army aviation.

A-1. M197 20-MILLIMETER GUN

The M197 20-millimeter gun is operated by 28 VDC, 115 VAC, 400 hertz power provided by the helicopter electrical system. The M97E2 universal turret weapon can be fired in the fixed or flexible mode by the pilot or in the flexible mode by the gunner. The turret fires a burst of 16 ± 4 rounds when the cyclic trigger switch is pressed to the first detent. It fires a continuous burst at 730 ± 50 rounds per minute when the cyclic trigger is pressed to the second detent. The capacity of the ammunition box and feed system is 750 rounds of continuously belted ammunition. This system is found on the AH-1G and AH-1S (ECAS/MC).

A-2. 2.75-INCH FOLDING FIN AERIAL ROCKET SUBSYSTEM

The 2.75-inch folding fin aerial rocket subsystem is a light antipersonnel assault weapon. Tube launchers of 7 to 19 rounds can be mounted on each of the inboard and outboard wing store racks. With the M138 rocket management system, the pilot is capable of selecting the desired type of 2.75-inch FFAR warhead, the fuze, the quantity, and the rate of fire.

A-3. HYDRA-70

The hydra-70 family of 2.75-inch FFARs is being designed to meet the requirements of low-speed aircraft in the air-to-ground role. A new multi-purpose submunition and an improved motor provide increased range, reduced dispersion, and an improved kill capability. A remotely settable electronic fuze accurately ejects submunitions creating a "wall in space." This eliminates range to target errors caused by variations in launch pitch angles. A broader range of warhead/fuze combinations allows for selective effects against targets and improves kill capability against materiel, personnel, and armor.

A-4. BGM71A TOW

The BGM71A tube-launched, optically tracked, wire-guided missile is a heavy antitank/assault weapon. This subsystem uses optical and infrared means to track a target and guide the missile. The

TOW is capable of engaging stationary or moving surface targets from 500 to 3,750 meters. The subsystem is designed to be effective during daylight conditions. Its use at night may be effective if flares are used to augment visibility. This system is found on the AH-1S (MOD/PROD/ECAS/MC).

A-5. M230E1 30-MILLIMETER GUN

The M230E1 30-millimeter gun is a single-barrel, externally powered, chain-driven weapon. It is mounted in a hydraulically driven turret on the AH-64. The rate of fire is 600 to 650 rounds per minute. The turret is capable of slewing the gun 110 degrees left or right in azimuth, elevating 11 degrees, and depressing 60 degrees.

A-6. POINT TARGET WEAPON SYSTEM

The point target weapon system is the primary armament of the AH-64 helicopter. It neutralizes tanks and other hard, point targets. The PTWS employs the Hellfire guided missile in a variety of modes in response to tactical conditions. These conditions include day and night operations, single and multiple launch sequences, line-of-sight and masked launches, and onboard, scout, and remote designators.

A-7. M129/M5 40-MILLIMETER GRENADE LAUNCHER

The M129/M5 40-millimeter grenade launcher is an electrically driven, rapid-firing, air-cooled weapon. The launcher is capable of firing 10-second bursts at 400 grenades per minute. The ammunition drum stores a maximum of 265 linked antipersonnel fragmentation grenades. This system is found on the AH-1G, AH-1S (MOD/PROD), and UH-1C/M.

A-8. M134 7.62-MILLIMETER MACHINE GUN

The M134 7.62-millimeter machine gun is an electrically driven, automatic, air-cooled, six-barrel weapon. The gun is capable of firing 6-second bursts at 2,000 to 4,000 rounds per minute. The

ammunition drum stores a maximum of 4,000 rounds of linked ammunition. This system is found on the AH-1G and AH-1S (MOD/PROD).

A-9. WING GUN POD

The wing gun pod is a self-contained unit, housing a 7.62-millimeter machine gun, an electrical system, a battery charging system, and a maximum of 1,500 rounds of ammunition. The gun is capable of firing 2,000 or 4,000 M18A1 or 4,000 M18 rounds per minute. This weapon system may be found on the AH-1S(MC).

A-10. M21 ARMAMENT SUBSYSTEM

The M21 armament subsystem consists of two M134 7.62-millimeter high rate of fire machine guns and two 7- or 19-round 2.75-inch aircraft rocket launchers. Rates of fire for the M21 machine guns are as follows: each (normal)—2,400 rounds per minute; each (high)—4,000 rounds per minute; both—4,800 rounds per minute. Maximum rate of

fire for 2.75-inch rockets is six pair per second. The M21 subsystem is found on UH-1C/M aircraft.

A-11. M22 SUBSYSTEM

The M22 subsystem consists of six externally wire-guided missiles, missile support and launching equipment, guidance control equipment, and the gunner and pilot tracking and aiming sights. The AGM22B can be fired at ranges between 500 and 3,500 meters. The missile has a 140-millimeter, 3 1/2-pound shaped charge high-explosive antitank warhead. Only one missile can be fired at a time. The M22 subsystem is found on UH-1C/M aircraft.

A-12. M60D MACHINE GUN

The M60D machine gun is a 7.62-millimeter weapon with a capacity of 550 rounds per gun. The maximum effective range is 1,100 meters, and it fires 550 to 650 rounds per minute. The M59 and M80 ball, M61 armor piercing, M62 tracer, and M63 dummy inert load can be used with the M60D. The M60D can be found on UH-1, CH-47, and UH-60 aircraft.

TRAINING DEVICES

Historically, service ammunition has been the primary training media; however, reductions in service ammunition for training are inevitable. The combat mission simulator and the Hellfire training missile are currently being fielded for the AH-64, and the flight weapons simulator is being fielded for the AH-1. These simulators or devices are high quality and cost-effective training alternatives. Simulation will significantly reduce problems associated with training such as the high cost of ammunition, restricted ranges and training areas, and logistical support. Used within training programs, these devices will maintain proficiency between live-fire exercises and eliminate the need to use actual ammunition for certain tasks.

B-1. AH-1 FLIGHT WEAPON SIMULATOR

a. The AH-1FWS consists of two cockpits, one for the pilot and one for the copilot/gunner. Each has an instructor station and is mounted on a six-degree-of-freedom motion platform. The simulator is computer controlled with a high resolution camera/model visual system. The pilot has a front and left side window display; the gunner has a front window display. Weapon effects are simulated through computer-generated imagery. The AH-1FWS simulates actual aircraft operations for all parameters of start-up, shut-down, ground maneuver, NOE and tactical operations, and weapon systems firing. The production AH-1FWS will be manufactured in the AH-1S(MC) configuration. Two cockpits can be computer delinked to allow multiple scenario training or simulation of two aircraft teams.

b. The AH-1FWS terrain board represents a tactical simulation. Superimposed over this simulated terrain are various firing points, target locations, and NOE routes. The targets and firing points can be used in various combinations and sequences to challenge the individual and crew as they undergo qualification and sustainment gunnery. For units having AH-1S(MC) aircraft, all individual tables will be executed on the AH-1FWS, when available. For units having the ECAS, the AH-1FWS can be used for TOW qualification (front seat only) and 20-millimeter turret firing (front seat only). For units having MOD or PROD aircraft, the AH-1FWS can be used for individual front seat TOW qualification only.

B-2. MULTIPLE INTEGRATED LASER ENGAGEMENT SYSTEM

a. The MILES system uses semiconductor laser beams to simulate actual weapon fire. An eye-safe

invisible laser beam is fired by each weapon's transmitter to simulate all of the weapon's capabilities including range, accuracy, and destructive capability.

b. Laser detection systems are used to sense opposing fire. The detection systems measure opposing laser beams to determine whether they have scored a "NEAR MISS," "HIT," or "KILL." The hit-receiving systems activate alarms that indicate the presence of and damage from opposing fire. When MILES is installed on the AH-1S, all weapons—the 20-millimeter cannon, 2.75-inch rockets, and TOW—are equipped with laser transmitters and are fired using normal weapon operating procedures. The helicopter exterior has a detector belt mounted to sense opposing fire. An aircraft loader's control assembly mounted inside the helicopter determines the effect of the opposing fire. A flashing light mounted on the aircraft's exterior is activated by the control console when opposing fire is detected. Smoke grenades are ignited to indicate when an aircraft has been "KILLED."

B-3. AIR-GROUND ENGAGEMENT SYSTEM

a. The AGES is an eye-safe laser engagement system compatible with the MILES. It consists of various devices that simulate both weapon firing and effect. These devices enable helicopters to participate in combined arms free play tactical training with real-time casualty assessment.

b. The AGES allows sustainment training and practice without the restrictions imposed by live fire. Simulated engagements may be conducted without regard to the range fan, ammunition resupply requirement, and safety precautions

normally associated with live fire. No specific safety precautions are required for MILES/AGES laser use. Imagination by the unit commander and subordinates increases the versatility of the AGES.

B-4. AH-64 COMBAT MISSION SIMULATOR

The CMS provides a significant training capability for flight and weapons delivery, normal and emergency procedures, and sensor system operating tasks required in the operational mission of the basic helicopter. The visual subsystems provide out-the-window scene and sensor imagery to each of the appropriate crew member video displays. Simulated imagery includes FLIR, DTV, and DVO. Weapon training functions are controlled from the instructor's module located behind each crew station module. The pilot and copilot/gunner can train individually or as a crew performing an integrated combat mission with all weapon systems. With the CMS, proficiency can be maintained in the 30-millimeter, 2.75-inch aerial rocket system, and Hellfire missile systems. The CMS gives crews combat-like experience not available with any other current training device.

B-5. HELLFIRE TRAINING MISSILE

The HTM assists in engagement procedures training. With these procedures, pilots can search, acquire, and compute an actual location with the missile laser seeker. This provides the flight crew all the pertinent tactical missile function information of an engagement with an actual missile. The HTM must be used with either an air-to-ground or ground-to-ground laser unit. It does not leave the rail.

B-6. HELLFIRE DUMMY MISSILE

The HDM is designed to assist the aircrew in handling characteristics similar to flying with actual missiles. It also allows armament handlers to practice loading and unloading procedures. The HDM replicates the weight and physical appearance of an actual missile and can be loaded on the armament rails. Unlike the Hellfire training missile, however, no electronics or cockpit displays are provided. The HDM will be fielded along with the aircraft.

B-7. COMBAT WEAPON AND EMERGENCY PROCEDURES TRAINER

The CWEPT provides training for AH-64 crew members in normal and emergency procedures. It

replicates the crew stations of the AH-64, to include all flight controls; target acquisition; and weapon, navigation, and communication systems. Visual displays are provided for all sensors, except out-the-window scenes. They display vector graphics including terrain features, threat arrays, and weapon effects. Crew members may train independently or as an integrated crew with or without instructor control. Two instructor station consoles are provided for input and monitoring by the instructor. The CWEPT is used to—

- Conduct initial qualification and refresher training in aircraft systems.
- Practice normal and emergency procedures and crew coordination.
- Improve operational techniques.
- Reduce system employment time lines.

B-8. TACTICAL RADAR THREAT GENERATOR

The TRTG provides an improved capability in electronic warfare training for aircrews in a realistic environment. The TRTG emits radar signals that simulate signals emitted by antiaircraft gun-laying radars and surface-to-air missile target-tracking radars. The TRTG elicits aircrew response to hostile radars and provides for effective aircrew survival instruction.

B-9. AH-1 SURROGATE TRAINER

The AH-1 surrogate trainer consists of an AH-1 aircraft modified to train AH-64 AQC students on the pilot night vision sensor. The AH-1 weapon systems are removed, and an actual PNVIS system from the AH-64 is installed. Currently, there are ten production surrogates at Fort Rucker, Alabama, for student training.

B-10. TADS SELECTED TASK TRAINER

The TADS selected task trainer replicates the copilot/gunner's station to provide procedures training. This training includes switchology, target recognition, target acquisition, launch procedures, and Doppler navigation. There are currently three devices in use at Fort Rucker, Alabama.

B-11. EYE-SAFE TRAINING AIRCRAFT LASER

The training aircraft laser will allow training of specific aircraft laser tasks. It is expected to be a switchable laser which will allow eye-safe, range-safe, and full power tactical lasing. Although the training aircraft laser program is still in the development stage, it has become apparent that there is a need for such a device Armywide.

APPENDIX C

SUGGESTED SCORER/EVALUATOR TRAINING PROGRAM

Each scorer/evaluator must be properly trained to participate effectively in an aerial gunnery program. The commander relies on the scorer/evaluator to ensure the gunnery training program meets the training objectives.

C-1. SCORER/EVALUATOR

a. The scorer/evaluator must be able to estimate range accurately. He must also be able to visualize the individual, crew, and team engagement sequences in the scenarios that are designed for each firing table. (Ranges should be known from firing points.) To facilitate detection of recurring faults in the unit training program, the scorer/evaluator should be available in the unit for at least 1 1/2 to 2 years.

b. Most units cannot afford the time, ammunition, or aircraft hours to completely train a scorer/evaluator. A person who already understands aircraft systems and how the scout-attack helicopter team operates will require less training. Scorers/evaluators are selected based on their experience in attack helicopter or air cavalry operations and aircraft manipulative skills. They are also selected based on their ability to transpose visual observations into meaningful training recommendations for the commander. In addition, the person must be able to express himself clearly, to explain clearly to individuals, crews, and teams the faults observed. Although a person is already assigned as a team or platoon leader or IP does not mean, in all cases, that he will make a good scorer/evaluator.

c. The primary concern in objectively scoring the firer is consistency. The scorer/evaluator must score each engagement from the optimum position and height and through the same optics. He must determine the visual cues that allow for consistent scoring. Before the actual firing, the scorer/evaluator should fly over the firing area to become familiar with the targets, firing points or boxes, and routes to and from various positions. An example of the scoring target effect is shown in Figure C-1.

C-2. ATTACK HELICOPTER MISSIONS AND METHODS OF EMPLOYMENT

Scorers/evaluators must thoroughly understand the tactical and doctrinal employment methods and organization of their unit to score/evaluate individuals, crews, and teams effectively. They

should be familiar with employment techniques and missions for attack helicopters in air cavalry or attack helicopter units.

C-3. SCORECARD

a. Before firing, the firer should receive a briefing on the scorecard. The scorecard specifies performance objectives and evaluates target engagements. Each target engagement is scored for target effect and exposure time. Both items are totaled, and the individual, crew, or team being evaluated must receive 75 percent or more to be qualified.

b. Remarks should be specific for each NO-GO to provide a basis for additional training. At the end of each table, the firer should be debriefed.

C-4. WEAPON SYSTEM CAPABILITIES AND ENGAGEMENT TECHNIQUES

A conference for aviators should be held to discuss the various aircraft weapon systems and engagement techniques. Because there is such a variety of weapon systems for the AH-1, AH-64, UH-60A, and UH-1, each unit should tailor the presentation to its own needs.

C-5. RANGE LAYOUT, TARGET SEQUENCE, AND SAFETY REQUIREMENTS

Each scorer/evaluator must be knowledgeable of the range layout, target sequence, and safety requirements. Scorers should be able to trace all possible movement routes, identify firing points in proper sequence, and discuss desired target engagement techniques and the effect from each. They should demonstrate this in flight over the range and graphically on paper. A detailed safety briefing is essential for a productive, accident-free gunnery cycle.

C-6. SAMPLE TRAINING PROGRAM

A sample training program is provided in Table C-1. The actual subject matter covered and times required should be adapted to the needs of each unit.

Figure C-1. Scoring target effect

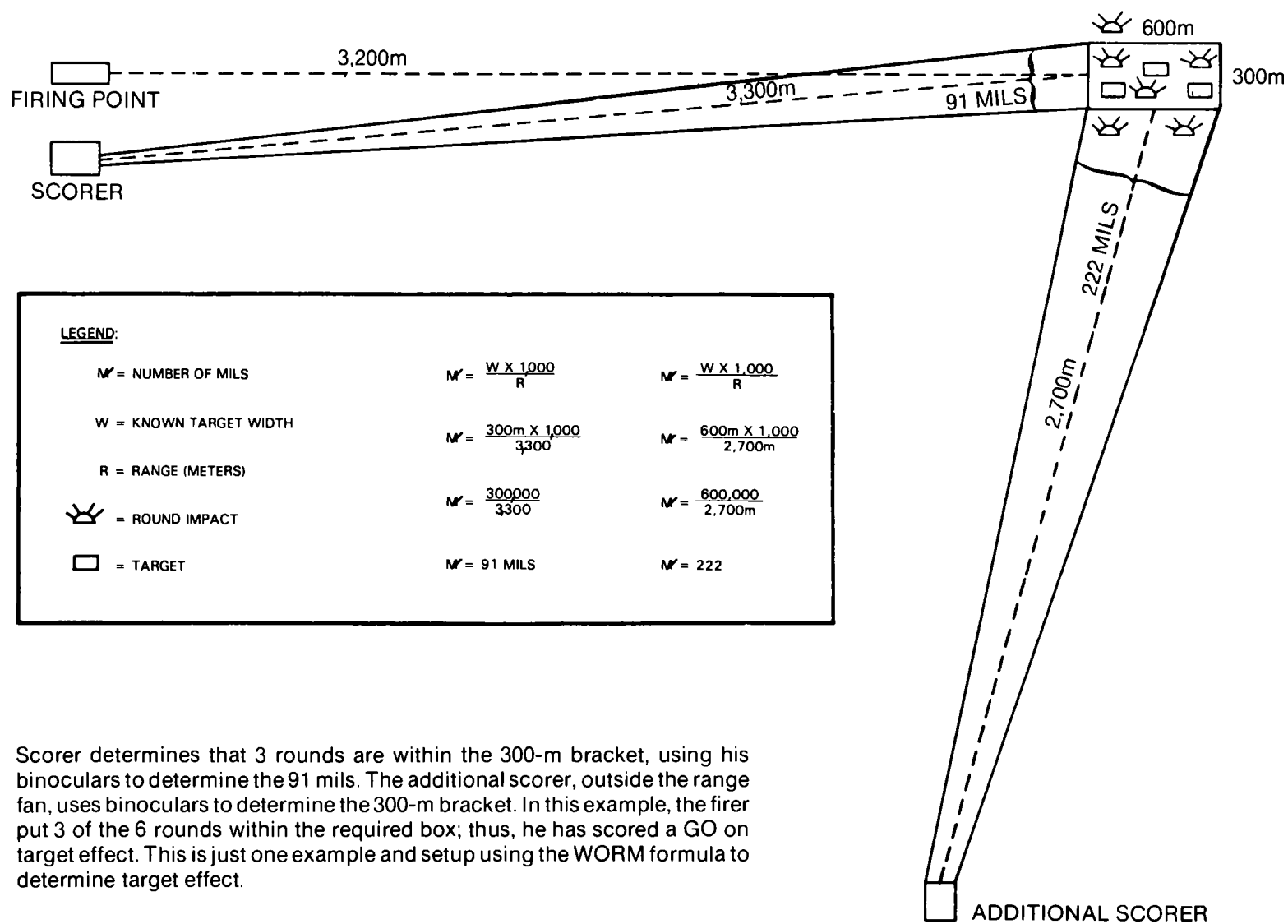


Table C-1. Suggested training program time

SUBJECT	HOURS
Attack Helicopter Missions and Methods of Employment	0.5
Scoring Criteria System	1.5
Exposure Times	0.3
Target Effect	0.4
Performance Measures	0.5
Aerial Gunnery Tables	0.3
Scorecard	0.2
Weapon System Capabilities and Engagement Techniques	0.3
Range Layout, Target Sequence, and Safety Requirements (to include orientation flights)	5.0
Total Hours	<u>7.5</u>

FEATURES AND SYSTEMS OF THE AH-1S(MC)

The AH-1S(MC) configuration includes a higher rated engine, transmission, and tail rotor drive system and an updated armament and fire control system. It has a larger 90-degree gearbox fairing; a nose-mounted TOW system TSU; and a seven-pane, low-reflective crew canopy. Other features include TOW system launchers on wing-tip articulating pylons, an infrared suppressor, an infrared jammer, and a chin-mounted uncowed universal turret subsystem. The AH-1S(MC) also includes a homing antenna; an airborne laser tracker; a 10 kilovolt-ampere, AC alternator fairing; and an omnidirectional airspeed sensor. The AH-1S(MC) incorporates two new weapon systems and several new weapon control subsystems.

D-1. M22 FIRE CONTROL COMPUTER

a. Components and Subsystems. The FCC forms the nucleus of the AH-1S(MC) integrated fire control system. Components of the FCC are a fire control computer and a boresight memory. The main fire control modes are target acquisition, target handover, and weapon delivery. Functions that the FCC performs to support the main fire control modes are—

- Mode switching.
- Signal processing management.
- Turret point corrections.
- Aircraft steering signals for the fixed gun and rocket mode.
- Cueing and reticle control signals to the HUD.
- Range calculations.
- Ballistic trajectory calculations.
- Interperipheral LOS transfers.
- Rocket fuze-setting calculations and output to the RMS.
- Continuously computed impact point.
- Continuously computed release point.
- Gunsight target-line calculations and input.
- Boresight corrections.

b. Weapon Delivery. The main fire control modes provide the most effective subsystems for delivery of the TOW, flexible gun, fixed gun, and rocket. The delivery of these weapons is described below.

(1) TOW. Targets are acquired directly by the HSS or indirectly by the ALT. TOW weapon delivery is completely under the control of the TOW system. The HUD generates prelaunch and post-launch windows and a gunner LOS cueing symbol for display on the HUD. These windows provide the pilot a visual indication of the permissible aircraft maneuver limits for the firing and subsequent postlaunch maneuvers of the TOW. Turret fire is inhibited for 1.5 seconds after TOW launch.

(2) Flexible gun. Targets are acquired directly by the HSS or indirectly by the ALT. Primary weapon delivery is controlled by the TSU. Secondary weapon delivery may be accomplished by either the pilot or the CPG using the HSS to control the UTS with limited (range) ballistic corrections applied.

(3) Fixed gun and rockets. Targets may be acquired directly by the HUD or indirectly by the TSU, ALT, or HSS with subsequent handover to the HUD. Weapon delivery is accomplished using HUD-displayed aircraft steering signals and sighting.

(4) Flexible gun and rockets. These two weapons can be used at the same time. However, during the firing sequence of the rockets, turret fire is stopped for 1.5 seconds as the rockets launch.

(5) Flexible gun and TOW. For these two weapons, the pilot may fire the UTS using the helmet sight subsystem while the CPG tracks the TOW in flight using the telescopic sight unit.

NOTE: Simultaneous firing of rockets and the TOW is not recommended because impact between them could occur during ballistic flight. Also, rocket sighting information is not available on the HUD.

c. Boresight Memory Module. The boresight memory module is a field-programmable memory module containing all the boresight constants associated with the fire control systems. The module is attached externally to the FCC. If the FCC fails, it is removed from the aircraft. However, the boresight memory module containing the boresight constants for that particular aircraft is mounted on the new FCC. This eliminates the need for reboresighting. Misalignment data are accepted. Compensation data are computed and stored in the module for fire control system combinations. These combinations are the—

- Turret gun to TSU.
- Turret gun to pilot's helmet sight.
- Turret gun to CPG's helmet sight.
- Pilot's helmet sight to TSU.
- CPG's helmet sight to TSU.
- Laser tracker to TSU.
- Heads-up display to TSU.

D-2. AIR DATA SUBSYSTEMS

The ADS provides the accurate measurement of air data: altitude, altitude rate (from radar altimeter), airspeed, sideslip angle, air temperature, and air density. Components of the ADS are the AADS, EPU, and LAI.

D-3. LASER RANGE FINDER

The AH-1S(MC) will not have the LRF during initial delivery but will have provisions to accept TSUs with the LRF installed. The LRF consists of the laser transmitter and receiver that mount on the TSU gimbal and a laser electronics unit located above the TSU and under the fairing covering of the TSU. Procedures for operating the LRF may be found in TM 55-1520-236-10.

a. The TOW control panel is modified to include the LRF control switches. Range readout is displayed through the TSR relay tube to the eyepiece in the CPG station. Electronic range data are sent

to the HUD and FCC. The LRF has a maximum range of $9,990 \pm 10$ meters and a minimum range of 200 ± 10 meters. Before any engagement, the gunner must set the minimum range for the LRF.

b. When the gunner selects a target in the TSU and desires range display, he depresses the LASER switch on the left handgrip. The laser will fire at a rate of four pulses per second for five seconds if the gunner holds the switch. The laser automatically shuts down for five seconds and then repeats the cycle. The range readout will show in the TSU and the HUD. The segmented lights in the TSU indicate:

- Red—laser return invalid.
- Yellow—laser inoperative.
- Flashing yellow—overtemperature condition.
- Green—multiple targets detected.
- Fourth light—another red light not currently used.

D-4. M65 AIRBORNE TOW SYSTEM

Although the switches and displays of the various Cobra models are somewhat different, basic techniques are used to fire the TOW. The AH-1S was developed to provide antiarmor capability employing the M65 airborne TOW. The AH-1S carries eight TOWs. The effective range of the TOW is from 500 to 3,750 meters. The capability of the TOW to destroy targets accurately at the maximum range gives the aircrew a standoff advantage over many air defense weapons. Under certain conditions, such as blowing dust and snow caused by rotor wash, aircrews should not attempt to fire the TOW because it is optically tracked.

a. Flight Time. The distance to the target determines the flight time of the missile. When it is fired from the hover, the missile's maximum flight time is 21.5 seconds. Table D-1 shows the flight times when targets are engaged at various ranges.

b. Wire Cutting. When the missile flies beyond the limit of the wire, impacts with the target, or loses optical or infrared LOS, the wire is automatically cut at the launcher. If an engagement has to be terminated, the gunner can cut the wire by depressing the electrical WIRE CUT switch on the TOW control panel. The pilot can cut the wire by pressing the WIRE CUT switch on the collective control head. There is no mechanical device to cut the wire while the helicopter is in flight. If the electrical WIRE CUT switch fails, the pilot should land as soon as possible so that a crew member can remove the wire.

c. Danger and Caution Areas. When the missile is fired, a danger area is created behind the helicopter (Figure D-1). This area of a 90-degree arc extends 45 degrees from each side of the launcher

Table D-1. TOW flight times

Meters	Seconds
3,750	21.5
3,000	15.0
2,000	8.8
1,000	4.0
500	2.0

f. Angle of Impact. When targets are engaged at ranges beyond 3,000 meters, the missile must fly with a nose-high attitude to maintain altitude. As the velocity of the missile decreases, the nose-high attitude increases. This causes the warhead to be less effective because of the increased angle of impact of the shaped charge with the target.

g. Boresight. Successful missile capture by the TSU missile tracker is affected by the boresight of the upper launcher module and TSU. The boresight of the HSS affects the target acquisition capability and accuracy of turret weapons. When either component is replaced, a portion of the boresight must be reconfirmed. Additionally, a portion of the boresight of the system is checked during each periodic inspection of the helicopter. Normally, DS contact teams perform the boresight evaluation and adjustment because of the special equipment and training required. The appropriate technical manual has specific information about this task.

h. Telescopic Sight Unit. The TOW system has a stabilized telescopic sight with low (2-power magnification) and high (13-power magnification) positions. The gunner can select either power by moving the MAG switch on the left handgrip of the TSU.

(1) When the gunner selects the LO position, he can see a 28-degree FOV. By applying pressure to the sight control, the gunner can move the telescopic turret (bucket). The bucket containing the optics can be moved in azimuth 110 degrees to the left and right of the helicopter centerline, 30 degrees in elevation, and 60 degrees in depression. The sight slews at a rate of 73 degrees per second in azimuth and 45 degrees per second in elevation for low magnification; it slews at a rate of 4.4 degrees per second in azimuth and 3 degrees per second in elevation in high magnification. When the sight is operating in the LO position, a circle is displayed on the sight reticle. This circle represents the field of view for high magnification (Figure D-2). With it, the gunner determines when he can move to high magnification without losing contact with the target. He also uses it to see in which direction and how far he must search to acquire the target after switching to the HI position.

(2) When the sight is operating in the HI position, the gunner can see a 4.6-degree FOV. The azimuth and elevation limits of the optics are the same as for the LO position. The reticle image displayed in the TSU consists of an outer circle with a vertical and a horizontal cross hair. Positioned along the horizontal cross hair, high magnification only, are vertical marks that aid the gunner in estimating range to the target. The distance between the outer vertical marks is 10 mils; the inner marks, 2 mils. At the center of the sight reticle is an opening that is 0.4 mil wide.

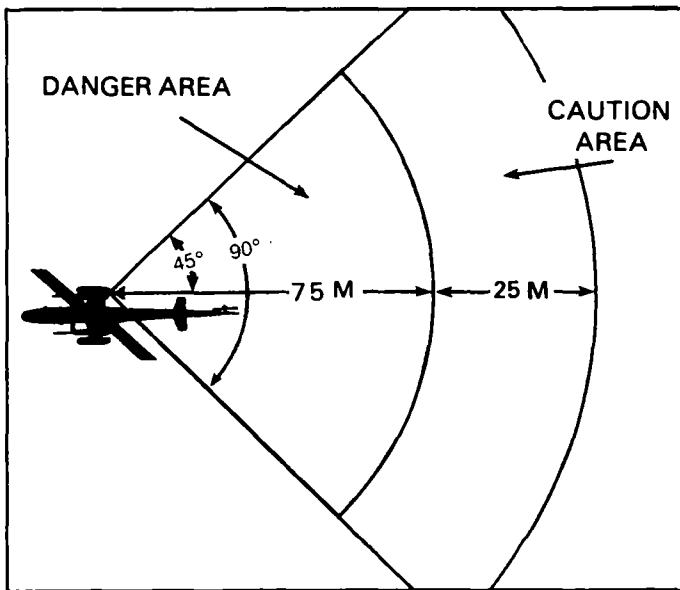


Figure D-1. TOW danger area

and extends back 75 meters. A caution area extending 25 meters beyond the danger area should also be avoided.

d. Launch Signature. The launch signature within these areas can be easily recognized from the flank. When observed from the front during the day, the signature is difficult to detect. It is more pronounced when the missile is fired OGE over terrain that has sparse vegetation. When the missile is fired at night, the glow produced by the missile is easily recognized from all directions.

e. Illumination. The light intensity of the target is reduced about 70 percent when the gunner views the target through the TSU. However, if he can see the target with the unaided eye, he can see it through the TSU. Normally, daylight conditions are adequate to see a target at the maximum range of the TOW system. Poor visibility and cloud coverage reduce the range at which the target can be seen. To acquire targets during darkness, the aircrew uses flares to illuminate the area.

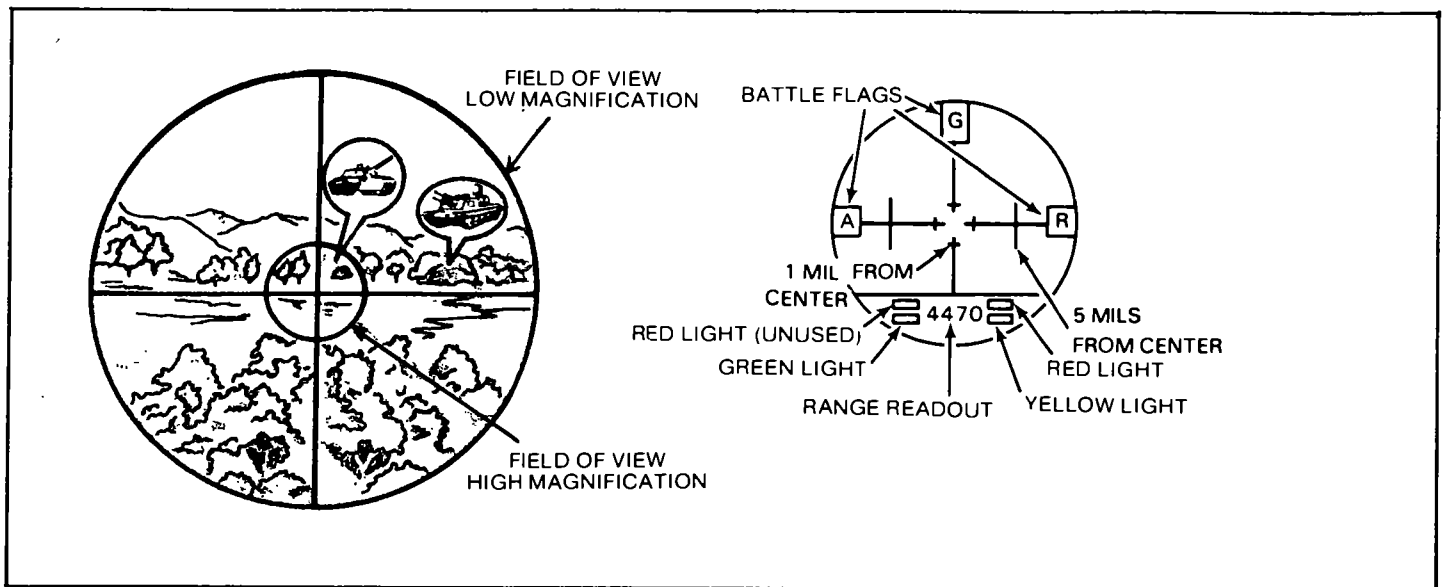


Figure D-2. TSU fields of view

This area displaces a 54-inch square at the maximum range, 3,750 meters, of the missile. This is the aiming point for the gunner when he is sighting on targets.

NOTE: As a rule, when gunners determine range to target for Soviet tanks, the mil values they use are 6.5 meters long and 3 meters wide.

i. Built-In Test Feature. Incorporated into the TOW system is a built-in test feature. The electronic circuit of the BIT is activated automatically when power is applied to the TOW system or when the BIT reset switch on the TOW control panel is depressed.

(1) During engine run-up, the pilot should place the master arm switch on the pilot's armament control panel to the STBY position. To operate the BIT, the CPG must position the mode selector switch on the TOW control panel to STBY + TOW or TSU/GUN and place the ATS switch to the STOW position. Once the circuit has been tested, a PWR ON flag will display on the annunciator window of the TOW control panel. Positioning the mode switch on the TOW control panel to the ARMED position locks out the BIT circuitry and causes the system to go directly to arm. *This procedure should be used only in an emergency.* The time required to complete the BIT varies from 30 to 120 seconds. The test circuit is incorporated into the missile guidance, stabilization, tracking, and power supply components. Continuous monitoring of the circuit occurs only in the EPS. It does not test the missile that has been selected for firing. Test circuits have not been incorporated into the other components because of their high reliability and safety requirements and the capability of the operator to observe a malfunction.

NOTE: When in TSU/GUN mode and in HI magnification, ensure TSU/GUN slew rate is in HI position.

(2) If the BIT indicates a malfunction of any component, the CPG should initiate another test before firing the TOW. Because of the variables of the test circuit, he should recycle as many as three times to confirm that a malfunction exists before aborting the mission. In a critical situation, the CPG should fire the missile to determine if the malfunction is only within the test circuit. If the missile can be captured and tracked to the target, the TOW system is operational. Continued firings can be conducted even though the test circuit indicates a malfunction. A component may fail after it has been tested by the BIT. The CPG would not be aware of the failure before firing a missile.

(3) If a missile is lost during launch, the CPG should place the TOW MODE SELECT switch to TSU/GUN or STBY + TOW to test the system. If a component failure is indicated, firing should be discontinued. The TOW system incorporates an LRU maintenance capability. The LRU capability allows organizational maintenance personnel to replace black boxes that the BIT indicates are defective. A DS contact team must perform further maintenance on the system using the TSGMS and TSEM.

(4) The distance the missile can be tracked laterally by the field sensor from the optical LOS decreases as the range of the missile from the helicopter increases. Figure D-3 shows TOW launch and capture constraints. At ranges beyond 520 meters, the capture capability of the field sensor is limited to 0.25 degree left or right of the optical LOS. If the missile flies outside these limits for 0.5 of a second or the field sensor loses infrared

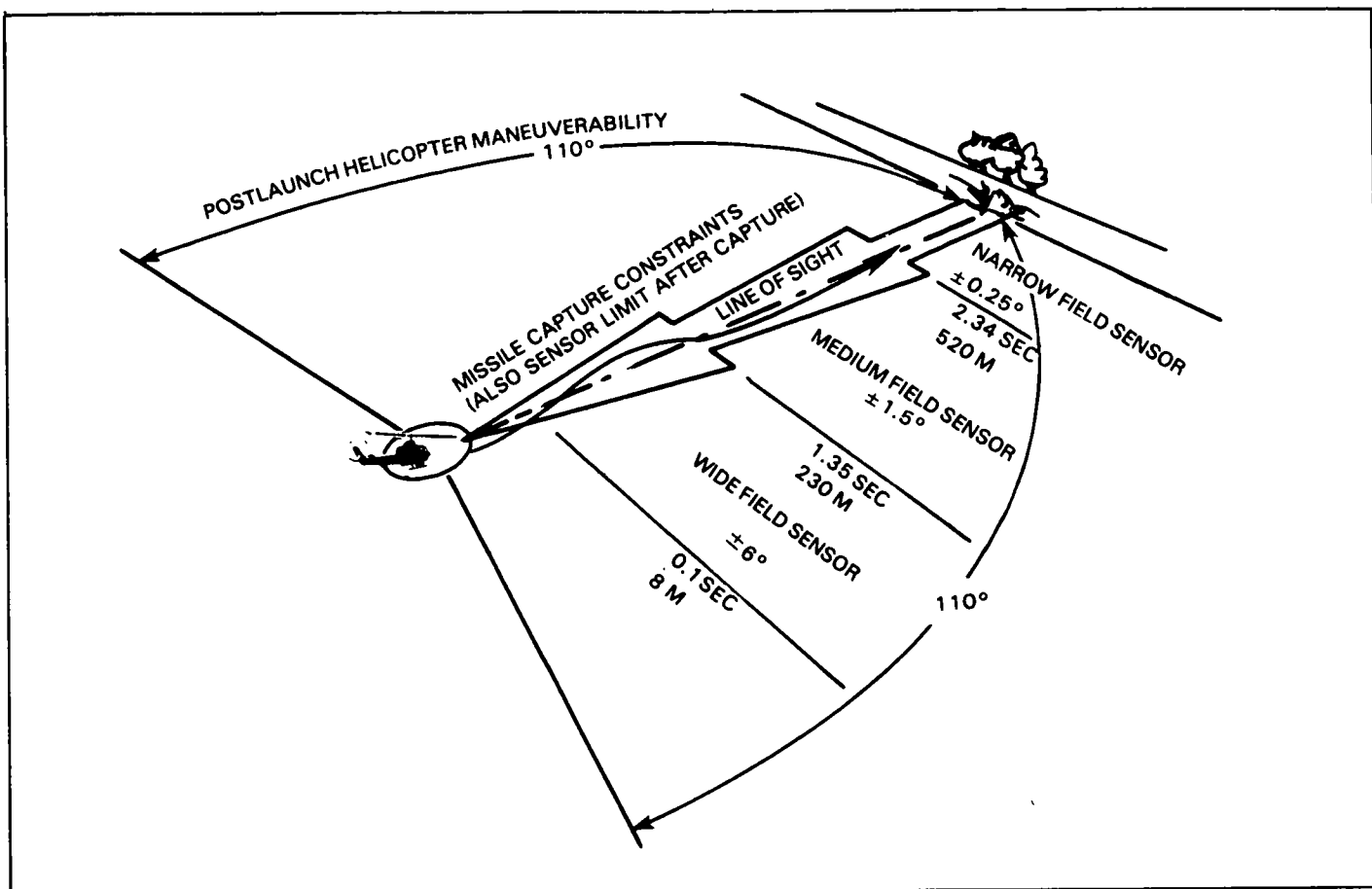


Figure D-3. TOW launch and capture constraints

LOS with the missile for 0.5 of a second, the wire is automatically cut. When a moving target is tracked or a target is engaged while the helicopter is moving, terrain obstacles sometimes appear between the helicopter and the missile. These obstacles may mask the infrared emitter from the field sensor and cause the wire to be cut automatically.

j. Launch and Capture Constraints. The helicopter must remain unmasked while the missile is in flight to the target. Although the time of missile flight is short, aircrews require additional time to acquire the target and maneuver the helicopter within prelaunch constraints. This gives the enemy sufficient time to acquire and engage the helicopter. If the helicopter is within effective range of an enemy weapon system, it is vulnerable to enemy fire. To minimize visual detection by the enemy, the aircrew should select a good firing position where the helicopter blends into the background.

(1) Incorporated into the TSU of the TOW system is a stabilized sight. When the system is in the track mode, the pointing angle of the sight is independent of aircraft heading changes. The TSU continues to point in the same direction without the

gunner making inputs to the track stick, regardless of the aircraft heading within postlaunch constraints. These constraints are azimuth 110 degrees left and right, 30 degrees elevation (nose down), 60 degrees depression (nose up) of the target line of sight, and 30 degrees roll. For example, if a stationary target is engaged when the helicopter is at a hover, the sight reticle remains on the target while the helicopter changes heading without the gunner making any inputs. If the target or the aircraft moves over the ground during the engagement, the gunner must press the sight hand control to correct for the changing LOS between the aircraft and target.

(2) To compensate for the effect of gravity drop on the missile after it leaves the launcher, the system sets the launcher pods 1 degree above optical LOS of the TSU. Additionally, the control surfaces (fins) are designed to impart an upward flight of the missile during launch. These features allow the pilot to fire the missile with only minimum obstacle clearance. This reduces the exposure of the helicopter.

(3) As a rule, if the pilot can maintain optical line of sight with the target, it can be engaged. To engage a target, the helicopter must be within the

prelaunch constraints. These constraints are 2.5 degrees left or right, 6 degrees in elevation and depression of the target line of sight, and within 5 degrees in roll. Sometimes the pilot has to maneuver the helicopter beyond the prelaunch constraints because of terrain variation and meteorological conditions. If prelaunch constraints are exceeded and normal procedures are used, the missile will not fire. The gunner can override the system by depressing the constraint override switch on the sight hand control. However, the probability of capturing the missile after launch is degraded.

(4) Firing the TOW while the helicopter is in a strong crosswind is the most difficult condition that confronts a pilot. The pilot can maintain alignment over a stationary position by slipping the helicopter into the wind. An out-of-trim condition is not critical. The roll constraint limitations, however, cannot be exceeded. After the missile has been launched, the helicopter may maneuver within the postlaunch constraints as long as optical LOS is maintained with the target.

(5) The pilot can maneuver the helicopter in either direction after a missile has been fired. However, he must make sure the missile wire does not become entangled in the turret weapons and break. To do this, he should maneuver the helicopter in the opposite direction from the side where the missile was fired.

(6) If the wire breaks during TOW flight, the last command signal received controls the missile steering system until impact. For instance, if the last signal is to climb, the missile continues to climb until its velocity decreases and gravity causes it to descend.

k. Firing at Extended Ranges. Using running fire when engaging targets with the TOW makes it possible to hit a target at a range greater than 3,750 meters. As an example, a Cobra traveling at 100 knots is crossing the ground at a rate of approximately 3 kilometers per minute. If a target is sighted at 4,750 meters, the Cobra could engage it because the TOW will travel 3,750 meters in 21.5 seconds. During those 21.5 seconds, the Cobra will have closed in on the target another 1 kilometer by flying directly toward the target. Tables D-2 and D-3 may be used in determining if targets can be hit at extended ranges.

l. Night Firing Techniques. When the gunner fires the TOW at night, the light intensity of the target is reduced approximately 70 percent as viewed through the TSU. Poor visibility and cloud coverage will reduce the range at which the gunner can see targets. To improve subsystem effectiveness at night, flares can be used to augment visibility. System performance at night will be degraded by glare on sight reticles and by the

Table D-2. Time and distance at 100 knots

<u>Kilometers</u>	<u>Minutes and Seconds</u>	<u>Nautical Miles</u>
1	:20	.55
2	:40	1.09
3.5	1:00	1.62
4	1:10	1.9
5	1:20	2.15
6	1:40	2.7
7	2:00	3.25
8	3:20	6.0

NOTE: An aircraft covers 1 kilometer every 20 seconds when traveling 100 knots across the ground.

Table D-3. Mils and range

<u>Setting (Mils)</u>	<u>STANDARD THREAT TANK Range</u>	
	<u>Head-on (Meters)</u>	<u>Flank (Meters)</u>
.4	8,700	17,000
.8	4,400	8,700
1.0	3,500	7,000
1.2	2,900	5,800
2.0		3,500

gunner's inability to adjust reticle intensity during tracking. Aircrews will have difficulty in acquiring targets during darkness. The intensity of the light produced by the missile motor and infrared emitter causes the gunner to lose track with the target until the missile is about 1,000 meters downrange. To compensate for this problem, one of the three night firing techniques explained below should be used.

(1) Following normal prelaunch tracking procedures, the gunner allows missile free-flight until he can regain positive visual contact with the target. At that time a correction is applied to align the sight reticle on the target properly. A constant aircraft heading is mandatory after launch until normal target tracking can be resumed. This technique may result in required corrections that exceed missile maneuver capabilities.

(2) Following normal prelaunch procedures, the gunner smoothly applies a left or right tracking

error to allow constant target visibility. As missile motor light intensity fades, the gunner smoothly corrects back to standard target tracking procedures. Figure D-4 depicts this method.

(3) Depending on the launch location, a ghost target is established either right or left of the actual target. The real target should be kept inside the perimeter of the sight reticle. When the missile is approximately 1,000 meters downrange, the gunner will make the transition to normal tracking procedures. This technique is generally considered the best alternative.

D-5. M138 ROCKET MANAGEMENT SUBSYSTEM

a. When the helicopter is equipped with 19-tube rocket launchers, the management of the four wing stores pylons' armament delivery is exercised through five zones of control. These zones are reduced to two or three zones when seven-tube rocket launchers are installed either on the outboard or on all four wing stores pylons. Rockets may be installed on outboard wing stores only if operation units are installed on the outboard wing stores.

b. The display unit consists of a control and display panel, a subsystem power supply, and a microcomputer and peripheral electronics section. The control and display panel is organized in four sections of indicators, displays, and switches. These are described below.

(1) The upper section of the ZONE INVENTORY display switch assembly consists of five thumb wheels. Each wheel contains one blank and eleven abbreviations or descriptors, each representing a warhead and flying combination. The pilot sets the thumb wheels to designate the type of rockets loaded into the rocket launcher zones. These wheels enable the pilot to select available rockets with warhead and fuze types as operationally desired simply by arming the desired rocket zone. To set the zones, the master arm switch *must be off*. To reset the zones, the master arm switch must again be turned off and the switches reset. Then the master arm switch is turned back on.

(2) Directly below each ZONE INVENTORY switch is a RND REM indicator that automatically displays the number of rockets remaining and

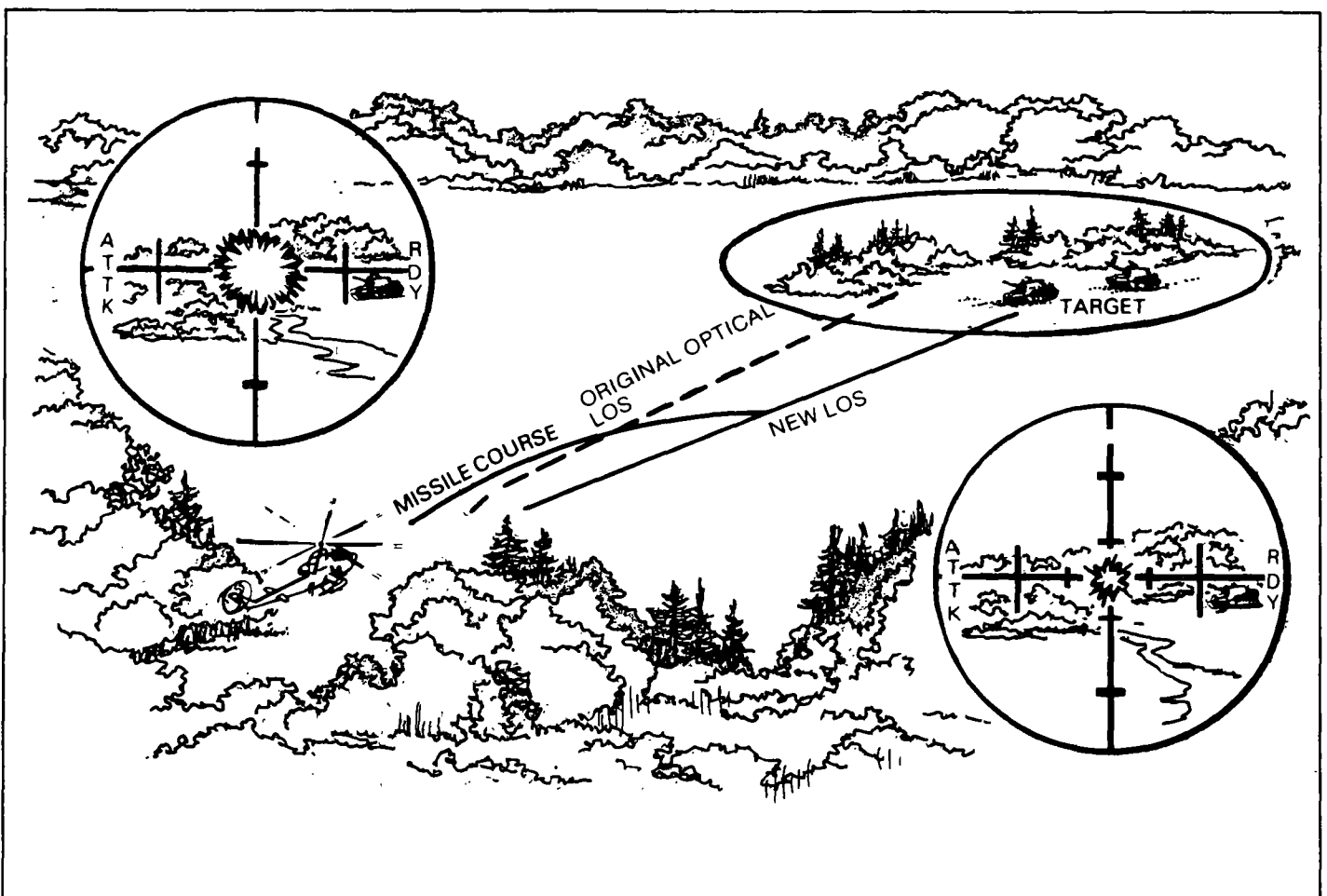


Figure D-4. Recommended night firing techniques

available in each zone. To the left of the RND REM display indicator is a push-button TEST switch. With the master arm in the STBY position, the TEST switch is pressed to initiate the automatic fault detection and location action of the subsystem self-test sequence.

(3) Five ZONE ARM switches located below the RND REM display indicator depict the configurations of the five corresponding zones above them. When pushed, the ZONE ARM switch provides power to activate the launch motors, warheads, and fuzes of rockets in *all* zones having the same type munitions. The master arm switch must be to the ARMED position to arm the zones.

(4) The PEN-M switch is used to manually set the M433 multioption RC fuze. This setting enables a rocket to penetrate the canopy formed by the mean tree height of a forest or the top of a building before the warhead is detonated. The thumb wheel is inscribed with 10 abbreviations or descriptors.

(5) The RATE switch controls the rate at which rockets are launched. The fast rate launches them at intervals of 60 ± 6 milliseconds; the slow rate, at 180 ± 18 milliseconds. In the automatic position, launch interval rates are those predetermined intervals which have been programmed for each warhead and fuzing combination available by the FCC.

(6) A MODE switch has three descriptors. These descriptors designate the number of rockets to be fired per cycle.

(7) A five-position QTY switch selects the number of launches to be executed in the modes designated by the MODE switch. The total rockets launched is the number of launches selected on the QTY switch multiplied by the number of rockets designated by the MODE switch.

(8) The manual range setting for the M439 airburst RC fuzes is done with the two thumb wheel switches labeled RNG-KM. These two thumb wheels are used together. The left thumb wheel establishes the 1,000-meter range increments; the right thumb wheel establishes the 100-meter range increments. The automatic range input position is used with a fire control computer or a laser range finder or both. When an aircraft has an FCC but no laser range finder, the RNG-KM thumb wheels can be used to manually feed range information to the FCC. The Doppler will continue to update the aircraft's position to the FCC for 15 seconds after the range thumb wheels are set.

D-6. FIRING THE TOW

a. Target Acquisition.

(1) The gunner may have difficulty acquiring a target at the maximum range with the helmet

sight. When he acquires the target, the gunner must move to the TSU after the helmet sight retracts. To acquire the target in the TSU, the gunner uses the LO magnification position. After he acquires the target in the TSU, the gunner is free to track the target with the sight hand control.

(2) The ALT track light (blue) on the ALT control panel informs the pilot when the ALT locks on to a target. The pilot must tell the gunner that the ALT has locked on to a target. The gunner then places the sight hand control switch in the TRK position and moves the ACQ switch to the ALT position. The TSU slews automatically to the target, and the gunner's helmet sight retracts.

b. Engagement Sequence. After acquiring the target, the gunner applies corrections with the sight hand control to bring the target within the inner circle of the sight reticle. As the target comes within the inner circle, the gunner selects the HI magnification position and depresses the action bar on the left handgrip. If all switches are set correctly, the "A" (attack) lighted segment appears in the TSU reticle. In the TOW prelaunch mode, the HUD indicates whether a left missile or right missile is to be fired. The gunner continues to track the target, keeping the aiming point on the center of mass while the pilot maneuvers the helicopter within prelaunch constraints. The pilot must position the gunner's LOS cueing symbol within the prelaunch constraints window.

c. Prelaunch. When the gunner's LOS is outside the field of view, an "X" flashes over the LOS symbol. When constraints are met, the "X" disappears. The ascend and descend pointers in the lower left corner of the HUD also give the pilot steering information (attitude). Anytime the pointers appear, the pilot makes an attitude adjustment in the direction indicated. Once the helicopter is within prelaunch constraints, the "R" (ready) lighted segment appears in the TSU sight reticle and the missile is ready to fire. If the helicopter is maneuvered outside prelaunch constraints after an "R" lighted segment is received, the light goes out and prelaunch constraints again must be met to fire the missile. Roll constraints are not displayed on the HUD. However, if the helicopter is banked more than 5 degrees, the "R" lighted segment does not appear and the gunner's LOS symbol flashes on the HUD.

d. Tracking.

(1) The probability that the missile will hit the target depends primarily on the gunner's ability to track the target. Tracking of a moving target is aided by the motion compensation circuitry. When an input is made to the sight hand control with the action bar depressed, the TSU moves in the direction that the control is pressed and at a rate equal to the input applied. A change in tracking rate can be made by pressing the sight hand control. The harder the pressure applied, the faster the

TSU slews. Anytime the action bar is released, the automatic tracking feature is de-energized. After missile launch, the motion compensation circuitry is automatically energized and the action bar can be released.

(2) The gunner's failure to apply immediate and smooth corrections is the primary cause of tracking error. As the range to the target increases, the effect of tracking error on the trajectory of the missile increases and the probability of hit decreases. Even with a perfect track, the missile has small deviations, normally less than 2 feet, about the line of sight. Therefore, tracking error must be reduced. It is critical that the aircrew track the target's center of mass smoothly and quickly, avoiding jerky corrections, to reduce tracking error.

(3) In addition to the tracking error, other variables affect the gunner's ability to track. For example, terrain features or smoke may momentarily block the gunner's line of sight to the target. The enemy may also initiate evasive maneuvers that cause the gunner to lose line of sight to the target. When the loss of a target occurs during engagement, the gunner continues tracking at the same rate as before the target was lost. He does not move the line of sight around in an attempt to see the target. When the target becomes visible again, he avoids steep inputs but immediately makes smooth corrections to position the sight reticle on the center of the mass. If the target does not appear before the missile reaches the range to the target, the gunner projects an intercept point. He tracks to this point until impact or until the missile is beyond the range of the target.

e. Postlaunch.

(1) When the missile trigger has been depressed, an "X" appears over the missile indicator on the HUD indicating that the missile launch sequence has started. About 1.5 seconds after trigger pull, the TOW postlaunch constraints appear on the HUD. The pilot must keep the gunner's LOS cueing symbol within the postlaunch window.

(2) The angular difference between the TSU line of sight and the heading of the helicopter is indicated by the course scale azimuth pointer located at the bottom of the HUD. The horizontal scale contains marks spaced 30 degrees apart, except the outermost marks which represent 110 degrees from center. The position of the azimuth pointer left or right of center indicates the number of degrees the helicopter is displaced from the TSU and the direction the pilot must correct to center the azimuth pointer.

(3) If the helicopter exceeds the postlaunch constraints, optical LOS with the target cannot be maintained and the missile will miss the target. If

the missile hits the target or exceeds range limitations, the postlaunch window extinguishes. This indicates that the wire has been cut automatically.

D-7. FIRING THE 2.75-INCH FFAR

a. Dispersion Beaten Zones. The beaten zones for hover and running fire are about the same at ranges of less than 3,000 meters. At longer ranges, the beaten zone for running fire is smaller than for the hover fire. The size of the beaten zone is also affected by the rate of fire (milliseconds). High rates of fire allow the rockets to leave the rocket launcher closer together. This improves their stability and decreases the size of the beaten zone.

b. Running and Hover Fires. The 2.75-inch FFAR can be used for direct and indirect running and hover fires. These fires are discussed below.

(1) Direct running fire. When the 2.75-inch FFAR is fired at NOE altitudes, direct running fire is the most accurate delivery. When it is fired at midranges of about 2,500 meters or less, the beaten zone is extremely long and narrow. As the engagement range increases, the length of the beaten zone decreases regardless of the airspeed or rocket launcher QE. A disadvantage of direct running fire delivery is that the helicopter gains altitude. This gain in altitude varies with the airspeed, the launcher QE, and the engagement range. For example, a maximum average gain of 67 feet is achieved with an airspeed of 90 knots, a launcher QE of 126 mils, and a range of 4,500 meters. The QE of the AH-1S(MC) is 71.2 mils, but the effect is similar.

(2) Indirect running fire. When targets are engaged at comparable ranges, the beaten zone for indirect fire is initially larger than for direct fire. To obtain the desired effect on a target, an observer can be used to adjust the impact of the rocket on the target. When crew members of the firing aircraft cannot see the target, they use the aircraft attitude and heading indicators to obtain a firing attitude and achieve accuracy.

(3) Direct hover fire. When delivering direct hover fire, the aircrew must maintain the helicopter in the nose-high attitude necessary to achieve the extended range. This requires that maximum power be used to perform a recovery and leaves little or no power in reserve. The helicopter is unsteady when changing from a stationary hover to a nose-high attitude and recovering to a stabilized hover. Aircrews can achieve greater accuracy by firing OGE because the air around the helicopter is less turbulent than when hovering IGE. The average length of the beaten zone for direct hover fire decreases as range increases. The width of the beaten zone increases, however, as the range increases.

(4) **Indirect hover fire.** Indirect hover fire delivery is less accurate than direct running fire. Both the stable and the pitching techniques can be used to engage targets in indirect hover fire delivery. To achieve the best effect on a target, an observer is used to make the adjustment.

c. **Modes of Operation Using the HUD.** The fire control systems on the AH-1S(MC) give the pilot a better capability for first-round target area hits with the 2.75-inch FFAR. There are five modes of operation in the delivery of this rocket using the heads-up display.

(1) **Rocket—direct mode.** This mode of operation gives the pilot a CCIP displayed on the HUD (Figure D-5). This mode should be used for short-to-medium ranges when the target is visible to the pilot through the HUD. In this mode, the gunner can give range information to the pilot by placing the TSU on the target and operating the laser range finder. The pilot may also dial in the estimated range on the RMS display unit. The TSU

in this mode does not furnish LOS information to the fire control computer. After a valid fire control solution is obtained, the pilot must position the aircraft so the fire control reticle is superimposed over the target. The pilot then applies smooth control movements so that rockets will not have a large dispersion area. When either the fire control reticle or the gunner's LOS cueing symbol is outside the HUD field of view, an "X" will be superimposed over the symbol.

(2) **Rocket—indirect mode.** This mode gives the pilot a CCRP instead of a CCIP on the HUD (Figure D-6). The CCRP represents a point from which the rockets must be launched for a target hit. This mode applies for any range of rocket firing when the pilot has to raise the nose so high that he loses visual contact with the target. The gunner must now have the TSU on the target for LOS information to both the FCC and the laser range finder. In this mode, the pilot must place the fire control reticle over the boresight reference symbol. When the two symbols coincide constituting the release point, the pilot fires.

(3) **Rocket—backup mode.**

(a) **First rocket—backup mode.** When the FCC fails, the HUD stops reading and displaying smooth range and starts reading raw laser range. An "L" precedes the laser range display and indicates that raw laser range is being displayed. An "LA" superimposed on the fire control reticle (Figure D-7) also alerts the pilot that the FCC has failed and that raw laser range is being used. In this mode, the HUD applies superelevation correction to the fire control reticle to compensate for ballistics based on the raw laser range. The fire control reticle is never displaced horizontally in the backup mode; therefore, the pilot must correct for winds. This backup mode is predicated on 120 knots of forward airspeed. Both the course azimuth pointer and the gunner's LOS

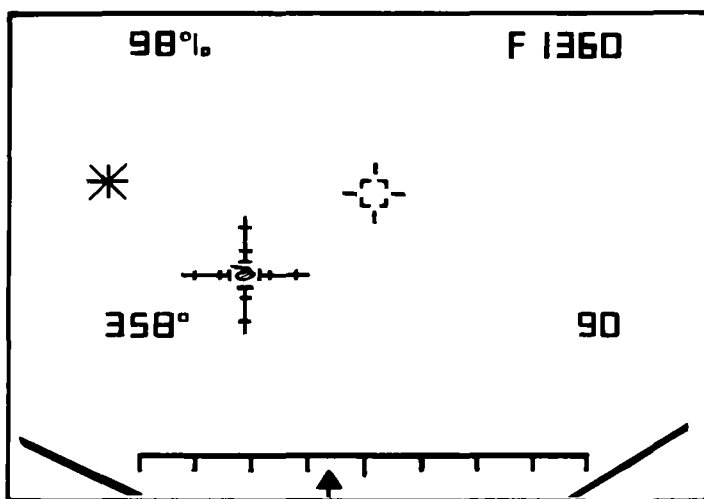


Figure D-5. HUD rocket-direct mode

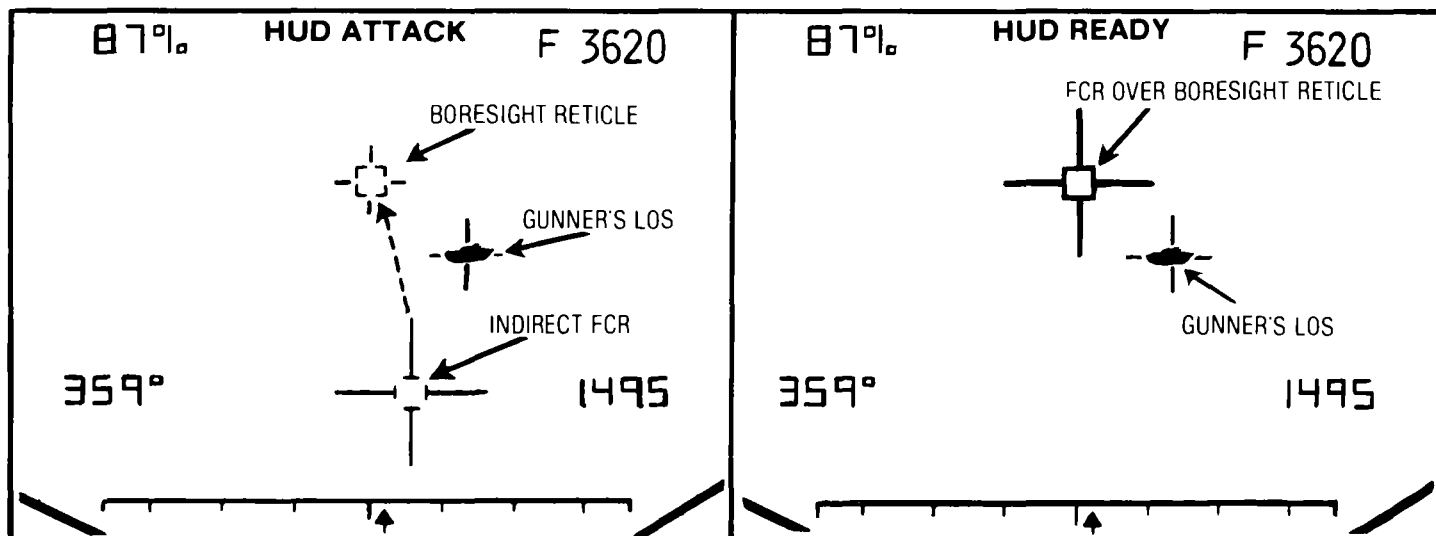


Figure D-6. HUD rocket-indirect mode

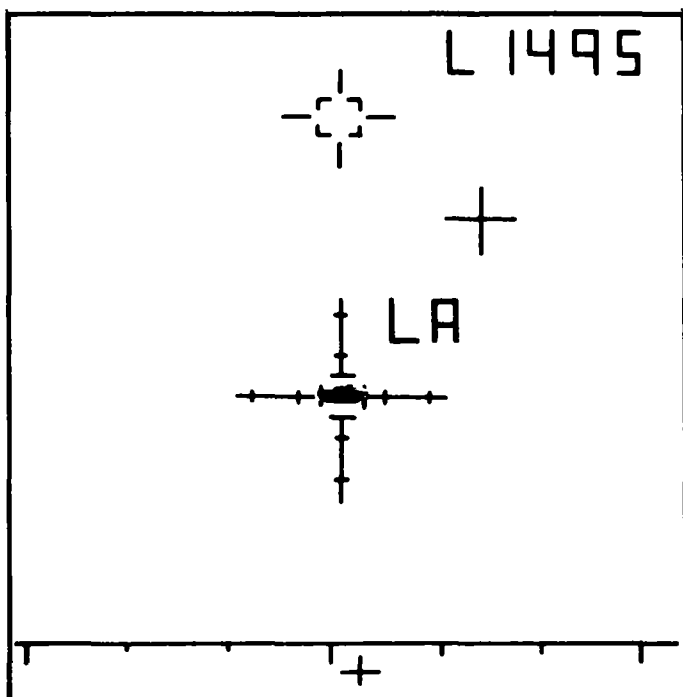


Figure D-7. First rocket-backup mode

symbol are displayed. Their only purpose is to inform the pilot of the TSU position. In this mode, the fire control reticle is completely independent of the gunner's LOS cueing symbol.

(b) Second rocket—backup mode. In this mode, both the FCC and the laser range finder have failed; therefore, there is no source of range data to the HUD. The pilot must compensate for estimated range by lining up the target with the

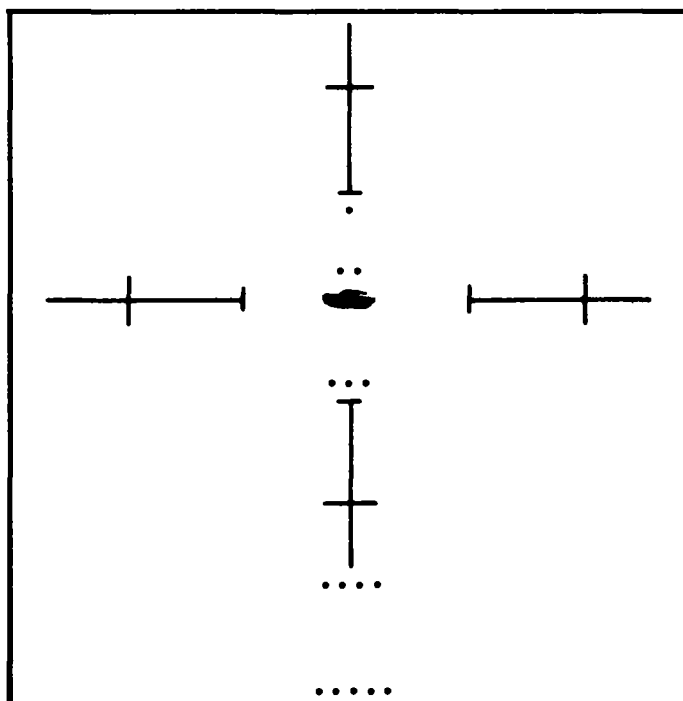


Figure D-8. Second rocket-backup mode

appropriate range marker on the stadiametric reticle. For example, if the estimated target range is 2,000 meters, the pilot must align the aircraft so the two dots are on the target (Figure D-8). The pilot must also compensate for wind when firing in this mode. The stadiametric mode is predicated on 120 knots of forward airspeed.

(4) Pilot-override mode. If the gunner has selected pilot override and the pilot has selected and armed a zone on the RMS, the gunner can fire only those rockets selected. The gunner must use a reference mark on the windshield as a sight. The gunner may also use his attitude indicator and RMI for rocket adjustment.

(5) Diving-fire mode. The stadiametric sight on the HUD was ideally designed to accommodate diving fire at 120 knots. As an example, a dive is initiated at 2,500 feet AGL at 100 knots. As the aircraft passes through 2,000 feet AGL at 120 knots, the pilot places the two-dot range marker of the stadiametric sight over the target to engage it effectively. As the altitude increases or decreases from 2,000 feet, the pilot needs to interpolate using the range markings on the stadiametric sight to obtain a combat sight setting. Diving fire may also be accomplished by using the direct-fire mode of the HUD if the pilot can determine the slant range to the target.

NOTE: When this maneuver is performed at night, extreme care must be exercised to avoid underflying flares and target fixation.

D-8. FIRING THE 17-POUND WARHEAD

The fire control computer in the AH-1S(MC) does not compensate for the additional weight of a 17-pound, HE warhead (M229). To fire this warhead accurately, the pilot must manually adjust the range thumb wheels on the RMS to reflect the correction factor (Table D-4).

a. To fire rockets in the indirect mode when neither crew member can see the target, the aircrew must know the heading and the approximate range to the target. With this information, the crew can use the attitude indicator to adjust the range of the rounds and the heading indicator to adjust deflection. Table D-5 is a guide for adjusting rounds in range and deflection. The table can also be a guideline when the QE of the rocket pod is 71.2 mils (4 degrees) and the attitude indicator is set wings-level on level ground (Figure D-9).

b. The pitch-up attitude is initiated by applying aft cyclic (Figure D-10). Collective pitch is added, simultaneously, to keep the tail rotor clear of obstacles. The desired pitch angle is indicated by the position of the miniature aircraft on the horizon bar. The bar width equals 2 degrees of pitch. When firing the rocket, the pilot must anticipate both the effect of tuck and the rearward movement of the helicopter. To adjust rounds in deflection, a rule of thumb for the pilot is that a 1-degree heading change moves the impact point about 20 meters at a range of 1,000 meters.

Table D-4. The 17-pound warhead correction factors

Range to Target (Meters)	Manual Hover (Meters)	RMS Input 60 Knots (Meters)
500	1,800	2,250
1,000	2,300	2,700
1,500	2,800	3,100
2,000	3,150	3,500
2,500	3,500	3,870
3,000	3,900	4,250
3,500	4,300	4,630
4,000	4,700	4,950
4,500	5,050	5,300
5,000	5,400	5,750

NOTE: Computer solutions only.

Table D-5. Indirect hover fire chart (QE 126 mils)

Rocket Flight Characteristics

Range to Target (Meters)	Pitch Attitude (Degrees) ^{1, 3}	Time of Flight (Seconds)	Maximum Trajectory Height (Feet)	Maximum Trajectory Range (Meters) ²
1,500	-5 (-2)	3.7	45	764
2,000	-4 (-1)	5.1	80	1,000
2,500	-3 (0)	6.5	150	1,400
3,000	-2 (+1)	8.4	260	1,700
3,500	-1 (+2)	10.5	455	1,995
4,000	+1 (+4)	12.5	608	2,220
4,500	+3 (+6)	15.2	905	2,535
5,000	+5 (+8)	18.6	1,378	3,050
5,500	+9 (+12)	22.0	1,764	3,156
6,000	+13 (+16)	26.0	2,788	3,600
6,500	+18 (+21)	31.0	3,908	3,951.2

¹ One bar width equals 2 degrees.² At this range, the rocket will reach the maximum trajectory height.³ Figures in parentheses represent the pitch attitude for the fully modernized Cobra (QE 71 [4°]).

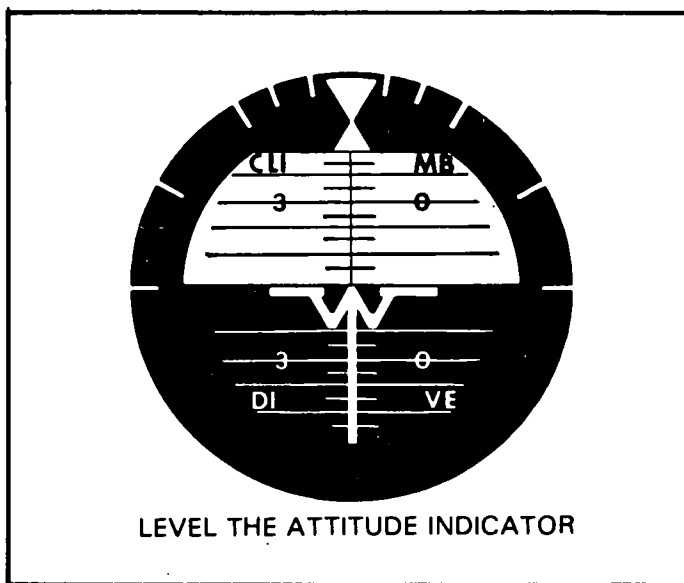


Figure D-9. Attitude indicator setting

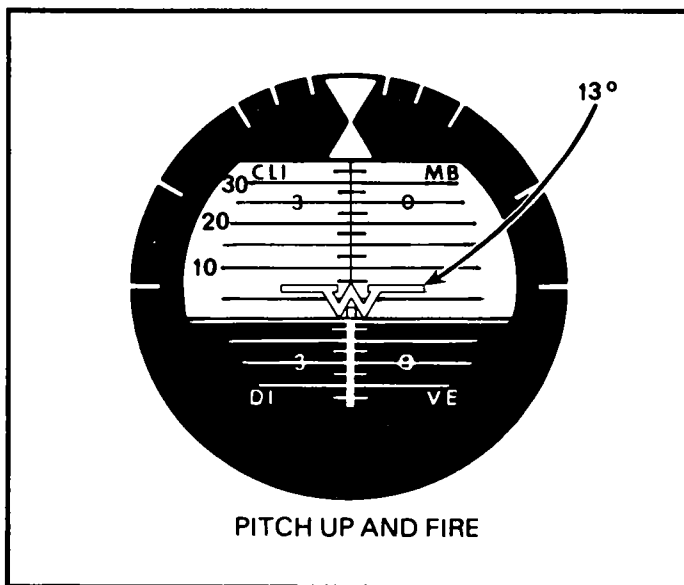


Figure D-10. Pitch-up attitude

c. A pilot can use the “rocking chair method” to prevent the aircraft from moving rearward when he raises the nose of the aircraft to engage a distant target. The pilot does this by having the aircraft in very slow forward flight (5 to 10 knots) before he raises the nose. This method can also prevent the aircraft from moving forward when the pilot lowers the nose to engage a close target. He has the aircraft moving rearward, 5 to 10 knots, just before lowering the nose of the aircraft.

D-9. FIRING THE M197 20-MILLIMETER CANNON

a. Firing Modes—Pilot.

(1) **Flex mode.** The pilot can fire the 20-millimeter in the flex mode using the HSS or in

the fixed mode using the HUD. To fire in the flex mode, the pilot places the weapons control switch in the PILOT position. He then squeezes the cyclic action bar. The 20-millimeter will follow where the HSS reticle is positioned. The only ballistic correction given to the pilot is the range switch setting, which is set to SHORT (1,000 meters), MED (1,500 meters), or LONG (2,000 meters). If the gunner has the TCP set to the STBY + TOW, ARMED AUTO, or ARMED MAN position, then the pilot's weapons control switch can be set to GUNNER and the pilot will still control the 20-millimeter.

(2) **Fixed mode.** In the fixed mode, the gun stows at 0-degree elevation and 0-degree azimuth. The pilot places the HUD's boresight reticle over the target, squeezes the cyclic action bar to illuminate the firing reticle, and then squeezes the trigger. In this mode, the pilot must make all of his own ballistic corrections.

b. **Firing Modes—Gunner.** The gunner can fire the 20-millimeter using either sighting system—the HSS or the TSU. There are two normal modes of employment and one emergency mode. These modes are explained below.

(1) Normal modes.

(a) **First normal mode.** For the gunner to use the TSU to fire the 20-millimeter, the pilot's weapons control switch must be placed in the GUNNER position. The gunner can then fire the 20-millimeter through the TSU in either the HI or LO magnification position. To do this, he presses the TSU action bar to allow the turret to follow the TSU and then presses the trigger to fire. The ATS switch must be in the TRK position. When the gunner fires the turret using the TSU, he can select three different slew rates. When the TSU magnification switch is in the LO position, the TSU always slews at 73 degrees per second in azimuth and 45 degrees per second in elevation. When the TSU magnification switch is in the HI position, the TSU slew rate depends on the position of the TSU/GUN slew rate switch. If it is in HI, the TSU slews at 27 degrees per second in azimuth and 22 degrees per second in elevation. If it is in LO, then the TSU slews at 4.4 degrees per second in azimuth and 3 degrees per second in elevation. If the TCP is in the TSU/GUN position and the gunner's action switch is pressed, laser data will be applied to the gun solution out to a maximum range of 2,000 meters. If no laser is available, the gunner's range switch provides the range data.

(b) **Second normal mode.** The gunner can also fire the 20-millimeter with the HSS using the left-hand action grip. To do this, the ATS switch must be in the STOW position. The gunner places the HSS over the target and squeezes the left-hand action grip to activate the turret weapon. He then sets the range switch to SHORT, MED, or LONG and squeezes the trigger.

(2) Emergency mode. To use the HSS, the gunner must place the pilot override switch to the OVERRIDE position, squeeze the cyclic action switch to allow the turret to follow where the HSS is looking, and then squeeze the trigger. The only ballistic correction is applied with the gunner's range switch, which is set to SHORT (1,000 meters), MED (1,500 meters), or LONG (2,000 meters).

NOTE: The TOW system is unusable in this mode.

D-10. FIRING WEAPONS SIMULTANEOUSLY

a. Simultaneous Gun and Rocket Fire. When the manual range switch is used with the HSS, turret and rocket fire can operate at the same time without degrading either mode. When the TSU is

used, these modes can operate simultaneously but the TSU cannot support both. While the TSU supports turret gunfire, it cannot support rocket fire. The rocket solution is valid only in the direct mode with RMS estimated range. When the pilot pushes the firing button to fire rockets, the 20-millimeter will stop firing for a brief moment. If the gun's azimuth is greater than 5 degrees off the aircraft's centerline, the gun will stow to 0-degree in azimuth.

b. Simultaneous Gun and TOW Fire. When the gunner fires a TOW, the 20-millimeter will stop firing for approximately 1.5 seconds and stow. Then it will start firing again.

c. Simultaneous TOW and Rocket Fire. The pilot could fire rockets during a TOW engagement. He will not, however, have a fire control reticle for aiming.

APPENDIX E

FIRING WEAPON SYSTEMS OF THE AH-1S(ECAS)

The AH-1S(ECAS) is equipped with the TOW system, the M138 rocket management subsystem, the 2.75-inch FFAR, and the M97E2 universal turret subsystem. This aircraft is also equipped with a seven-pane, low-reflective crew canopy which increases battlefield survivability. Procedures for firing the weapon systems on the AH-1S(ECAS) are discussed in this appendix.

E-1. SYSTEMS

a. M73 Reflex Sight. The M73 reflex sight is used when the 2.75-inch FFAR is fired in the direct mode. It is also used when the 20-millimeter cannon is fired in the fixed position.

b. Helmet Sight Subsystem. With the helmet sight subsystem, the pilot or gunner can acquire visible targets rapidly. For a description of this subsystem, see paragraph D-6.

c. M65 Airborne TOW System. The AH-1S was developed to provide antiarmor capability employing the M65 airborne TOW. The description is in paragraph D-4.

d. M138 Rocket Management Subsystem. With the M138 rocket management subsystem, the pilot is capable of selecting the desired type of 2.75-inch FFAR warhead, fuze, quantity, and rate of fire. The description is in paragraph A-2.

e. M97E2 Universal Turret Subsystem. The universal turret provides fixed or flexible fire for 20-millimeter, 40-millimeter, and 7.62 weapon systems. The description is in paragraph D-10.

E-2. FIRING THE TOW

The TOW status indicator on the pilot's instrument panel will indicate whether a missile is selected from the right (R TOW) or left (L TOW) launcher. When the gunner turns the TCP to the ARMED AUTO or ARMED MAN position, a barber pole will appear if no missile is selected.

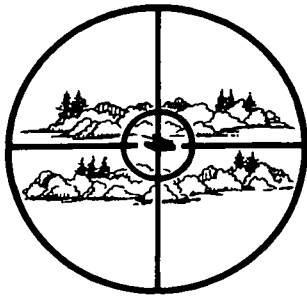
a. Engagement Sequence.

(1) After acquiring the target, the gunner applies corrections with the sight hand control to bring the target within the inner circle of the sight reticle (Figure E-1). As the target comes within the

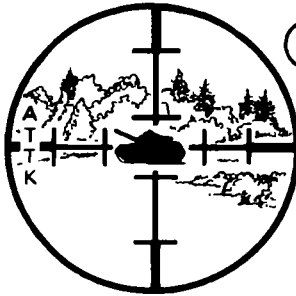
inner circle, the gunner selects the HI MAG position and depresses the action bar on the left handgrip. Immediately, the ATTK flag on the gunner's sight reticle appears, and the attack annunciator flag on the PSI is displayed. The gunner continues to track the target, keeping the aiming point on the center of mass while the pilot maneuvers the helicopter within prelaunch constraints.

(2) Both azimuth and pitch attitude constraints for prelaunch are displayed to the pilot within the PSI. Vertical and horizontal sight line position bars displayed within the PSI provide steering information. These bars react similarly to the course deviation needle and glide slope of an ILS receiver. If the vertical bar is deflected to the left of center, the helicopter heading is right of the optical LOS and must be corrected to the left. If the horizontal bar is below center, the attitude of the helicopter is above the optical LOS, and the pilot must adjust the attitude downward. The ascend and descend pointers in the inner box of the PSI also give steering information (attitude). Anytime the pointer appears, the pilot must make an attitude adjustment in the direction indicated to position the helicopter parallel to the optical LOS.

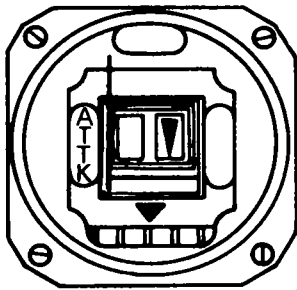
(3) The pilot tries to center the sight line position bars to bring the helicopter within prelaunch constraints. These constraints are satisfied when both bars are within the inner box. Once the helicopter is within constraints, the RDY flag on the PSI and the RDY flag on the sight reticle of the TSU appear. All prelaunch requirements have now been satisfied, and the missile is ready to be fired. If the pilot maneuvers the helicopter outside the prelaunch constraints after he receives a ready indication, the RDY flag will disappear. He must then maneuver the helicopter back within the prelaunch constraints for the gunner to fire the missile. Roll constraints are not displayed on



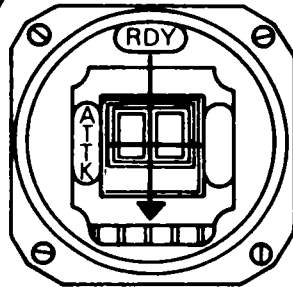
- ① The gunner positions the target within the high magnification circle of the TSU in low power.



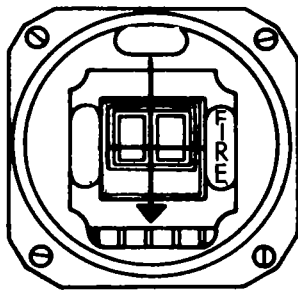
- ② He then switches to high magnification and depresses the action bar on the left handgrip.



- ③ The ATTK flag is displayed on the PSI.



- ④ The pilot maneuvers the helicopter to center the sight lines on the PSI; the RDY flag will be displayed, indicating the gunner can fire the missile.



- ⑤ When the missile exits the tube, the ATTK and RDY flags disappear and the FIRE flag is displayed in the right area of the PSI.



- ⑥ The gunner fires when the RDY flag on the TSU is displayed. When the missile exits the tube, the ATTK and RDY flags disappear.

Figure E-1. Engagement sequence

the PSI. However, the RDY flag will not appear if the helicopter is banked more than 5 degrees. To fire the missile, the gunner must depress the action bar and the firing trigger on the TSU left handgrip.

b. Tracking. Tracking the missile in the AH-1S(ECAS) is the same as tracking it in the AH-1S(MC). Tracking requires smooth, steady corrections for the best results.

E-3. FIRING THE 2.75-INCH FFAR

a. Direct Fire Delivery Techniques.

(1) Sight card use. When direct firing the 2.75-inch FFAR, the aircrew should use the mil setting shown on the sight card (Table E-1) for the appropriate airspeed and range and launcher QE settings. To achieve greater accuracy when using the sight card, the aircrew should first fire the weapon and then compute the ballistic correction by applying it to the mil setting. The sight card is computed for a 10-pound warhead. A lighter warhead causes the rocket to impact beyond the target, a heavier one short of the target. The range achieved for a given gunsight setting does not change when rockets are fired from altitudes between zero and 200 feet AGL. A 5-mil change on the M73 gunsight causes the rocket to move 100 meters in range. The gunner uses a sight card containing mil settings for specific flight conditions and ranges to determine the mil setting on the gunsight. To this value, he applies a ballistic correction factor which compensates for meteorological conditions and interior ballistics.

CAUTION

For engaging targets beyond 3,000 meters with a 17-pound warhead, an extreme nose-high aircraft attitude must be achieved. Before firing, aircrews must use extreme caution to make sure of obstacle clearance to the rear and below the aircraft.

(2) Ballistic correction procedure. To determine the ballistic correction, the pilot uses the procedures that follow. He selects a target at about half the effective range of the weapons or the range at which the greatest number of targets will be engaged. When firing the rocket armed with a 10-pound, HE warhead, he normally uses a 2,500-meter range. After he determines the engagement range, he sets the gunsight by rotating the ELEVATION/DEPRESSION knob the required number of mils. For example, the pilot knows the rocket launchers are set at a QE of 126 mils. The range to the target is 2,500 meters, and the engagement airspeed is 0 knot. With this information, the pilot refers to the sight card, reads -66 mils and sets the knob at that mil setting (Figure E-2). The pilot uses the proper power setting for the desired airspeed and altitude and then adjusts the pitch attitude until the pipper is superimposed on the target. When he gets the desired sight picture, he fires one pair of rockets. The pilot notes the mean point of impact. He then estimates the distance the burst is either short of or beyond the target. He converts range error to a mil

Table E-1. Sight card for the M73 gunsight

RANGE (METERS)	AIRSPEED (KNOTS)														
	0			30			60			90			120		
	QE			QE			QE			QE			QE		
	103	126	140	103	126	140	103	126	140	103	126	140	103	126	140
1,000	-84	-106	-120	0	-28	-25	-5	-20	-33	-35	-32	-50	-64	-68	-78
1,500	-73	-95	-109	13	-15	-17	-7	-10	-17	-20	-23	-35	-52	-60	-67
2,000	-60	-83	-97	28	0	-5	20	4	-5	-3	-10	-18	-37	-46	-52
2,500	-43	-66	-80	45	17	10	42	22	12	13	5	-2	-19	-28	-34
3,000	-22	-44	-58	65	40	32	62	45	28	32	22	15	2	-7	12
3,500	+4	-19	-33	90	68	57	86	70	55	54	48	37	26	17	11
4,000	+34	+12	-2	125	95	87	113	95	80	80	73	57	52	42	37
4,500	+71	+49	+35	150	125	117	140	122	110	105	97	87	79	70	64
5,000	+116	+94	+80	180	150	150	168	148	145	132	123	127	109	100	93
5,500	+172	+149	+135	207	177	180	195	173	182	160	148	170	141	132	123

NOTE: The sight is computed for a 2.75-inch FFAR with a 10-pound warhead at 9,200 pounds gross weight. For a 17-pound warhead, 40 mils are added to the above mil setting for a less than 3,000-meter range.

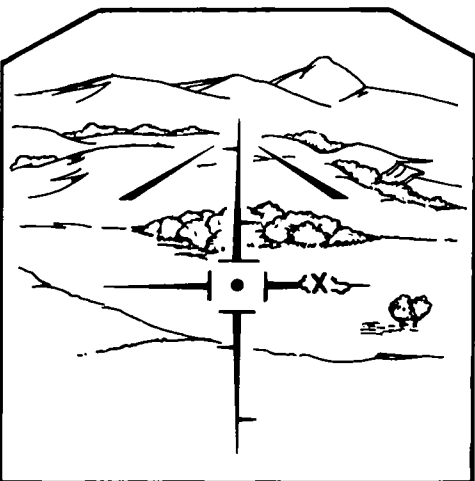
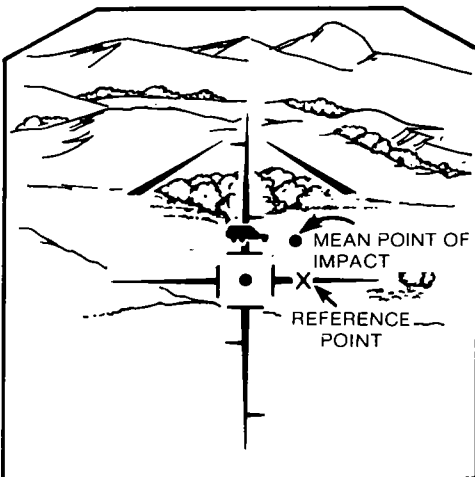
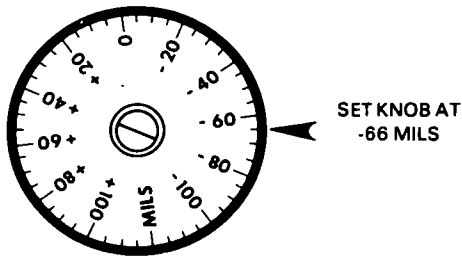
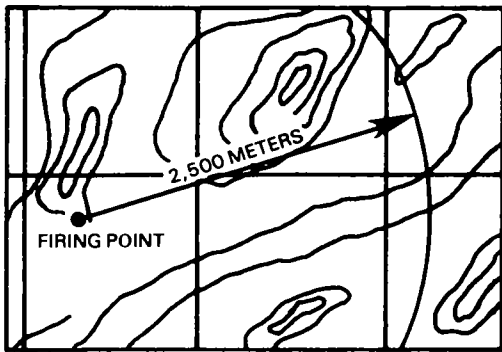


Figure E-2. Ballistic correction procedure

correction by making a 5-mil change in elevation for every 100 meters of range error. He then applies that correction to the ELEVATION/DEPRESSION knob. If, for example, the projectile impacts 200 meters short of the target, 10 mils must be added to the original gunsight setting, making the new setting -56. This adjustment results in the projectile hitting the target. The pilot uses the horizontal cross hair to measure the deflection that occurs when the rocket is fired. Several firings may be necessary to confirm an accurate ballistic correction factor.

(3) Direct running fire. For direct running fire, a firing point on the ground must be selected from which the weapon system will be fired. The location of the firing point must provide unobstructed visibility to the target. The distance to the target, if preplanned, should be about the same as one of the ranges on the sight cards. The pilot can determine a firing point by drawing one or more arcs at varying ranges, using the target as the center of focus of the arc. The gunner tentatively selects primary and alternate firing points by map reconnaissance (Figure E-3). During the mission, he makes the final selections. The pilot determines the mil setting corresponding to the desired range on the sight card and applies the ballistic correction. He then places the resulting value on the mil scale of the gunsight. The pilot establishes a flight path that causes the helicopter to overfly the firing point while maintaining the desired direction of fire. The pilot then aligns the helicopter with the target when the vertical hairline on the gunsight reticle is centered on the target. Just before reaching the firing point, the pilot must apply aft cyclic to raise the nose of the helicopter to position the horizontal hairline on the target. The pilot applies continuous aft cyclic pressure. To achieve greater accuracy, the pilot should establish and maintain a stabilized power setting throughout the maneuver. Abrupt movement of the cyclic reduces the accuracy of the weapon system and causes an increase in the height of climb during the maneuver. Slower airspeeds and smoother application of control movements will reduce the amount of climb. The length of time the pilot can hold the gunsight on the target is limited. He should stop firing when he can no longer maintain the sight picture. This limitation applies to all delivery techniques that require a pitching motion to attain the desired firing attitude. After the pilot fires the initial volley, he decides to reengage and makes the necessary adjustments. He returns to the starting point and repeats the running fire procedures. The pilot selects the alternate firing points to avoid repeated overflights of the primary firing point (Figure E-4).

(4) Direct hover fire. Once the pilot determines the mil setting and makes the proper adjustments, he engages the target by applying the necessary cyclic input to put the pipper on the target. At the same time, he applies collective pitch

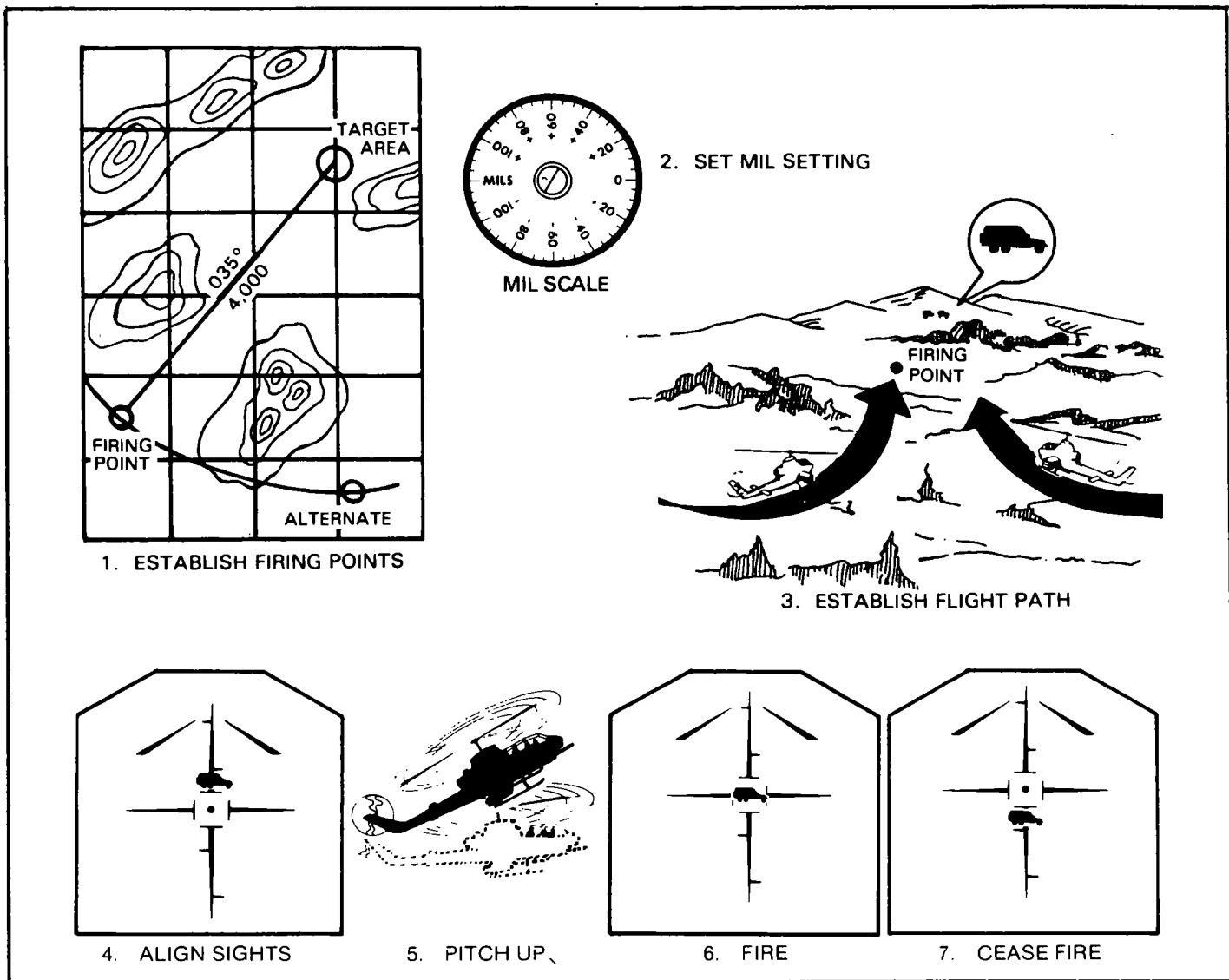


Figure E-3. Mission sequence—running fire

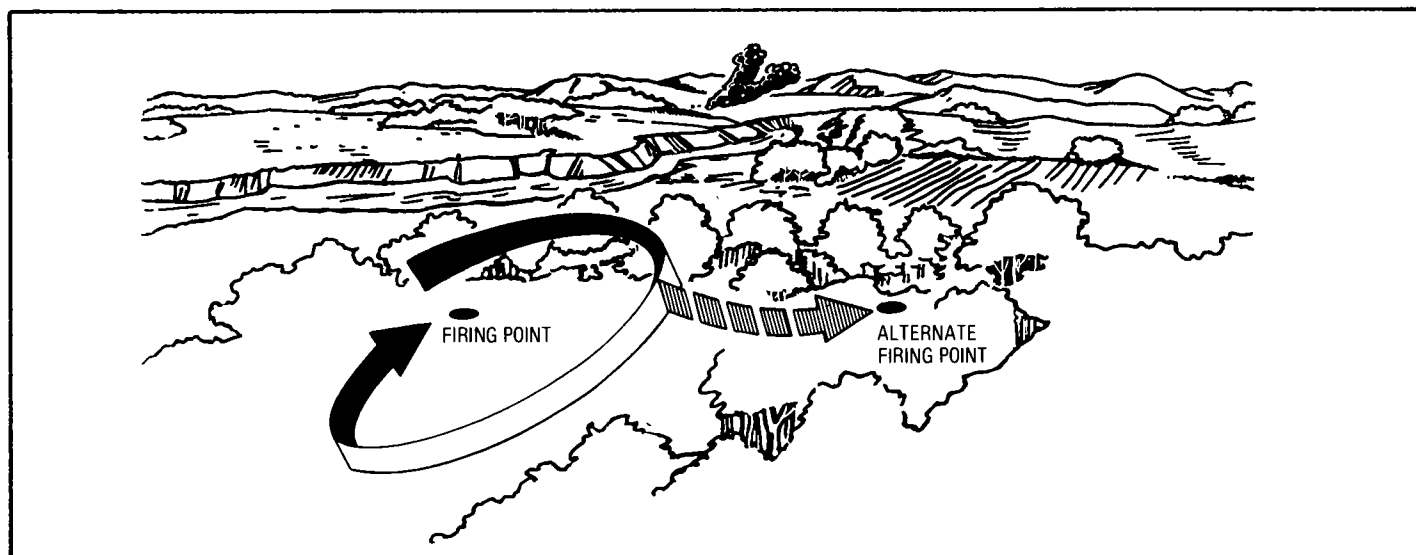


Figure E-4. Use of alternate firing points

to keep the tail rotor from hitting terrain obstacles. When the correct sight picture is achieved, the pilot fires the weapon (Figure E-5). When targets are engaged at short ranges, forward movement may occur because the aircraft will be in the nose-low attitude required to hit the target (Figure E-6). The reverse is true when targets are engaged at the maximum range of the weapon system. Before the pilot fires the rocket, he must make sure the helicopter is clear of obstacles behind and below it (Figure E-7). The rocking chair method described in paragraph D-8c is a stable and safe rocket delivery procedure.

(5) Direct fire adjustment. To adjust direct fire, the aircrew observes the impact of the rockets and senses corrections required to hit the target. For example, the pilot senses a requirement to correct left 100 meters and add 500 meters. The range to the target is about 3,500 meters. The pilot uses the rule that a 5-mil change in elevation moves the impact point of the rocket 100 meters. A +25-mil correction is applied to the gunsight to increase the range 500 meters. The pilot can determine the deflection correction by observing the lateral displacement of the rocket from the vertical centerline of the gunsight (Figure E-8). He can mark a reference point on the horizontal hairline of the sight reticle or mentally note the point of impact. This point is the aiming reference to correct for deflection when the pilot fires subsequent engagements.

b. Indirect Fire Delivery Techniques. Indirect fire is used primarily against area targets. The delivery techniques for indirect fire and those for direct fire are different. They differ primarily in the means for determining the correct pitch attitude for the different ranges and the method of aiming the weapons. Since indirect delivery techniques have not been developed for flex weapons, only those for stowed weapons are discussed. To deliver indirect hover or running fire, the helicopter attitude indicator is the primary means of determining the pitch attitude required (Figure E-9) to attain the desired range (Table E-2). Two additional techniques are the distant aiming point and the stable fire techniques. Specific techniques for conducting indirect fire with the 2.75-inch FFAR are described below.

(1) Indirect running fire using the attitude indicator.

(a) Firing point selection. With indirect running fire, a firing point on the ground must be selected from which the weapon system will be fired. The method of selecting a firing point is the same as that discussed in paragraph a(3) above for direct fire, except the target is not seen from the firing point. The direction to the target is determined using a tactical map, and then it is converted to a magnetic heading.

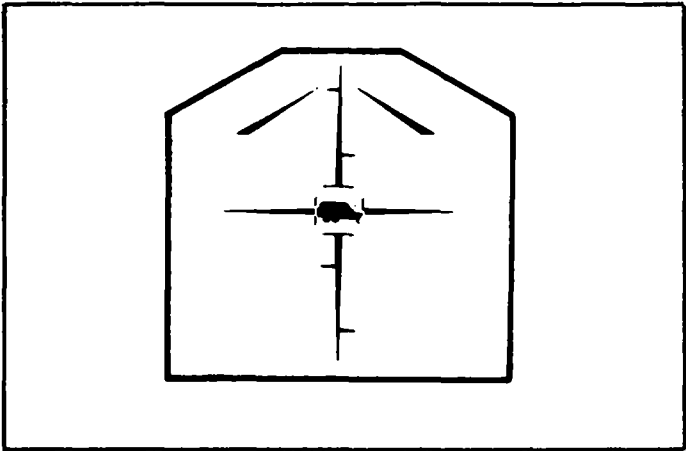


Figure E-5. Correct sight picture

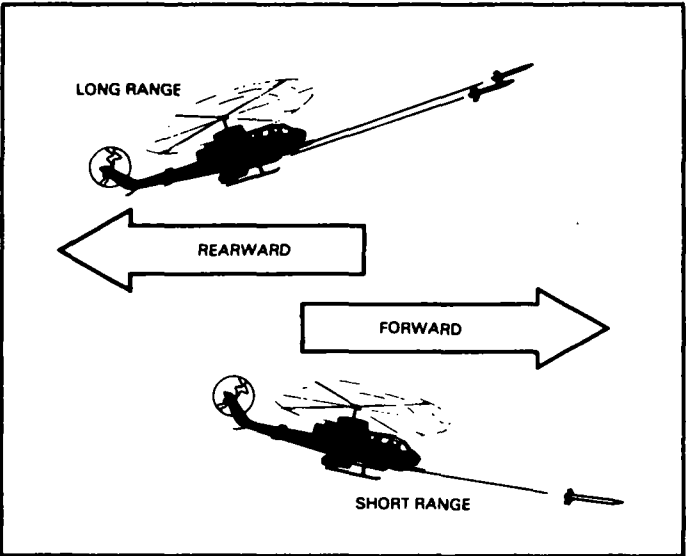


Figure E-6. Long-range and short-range delivery techniques

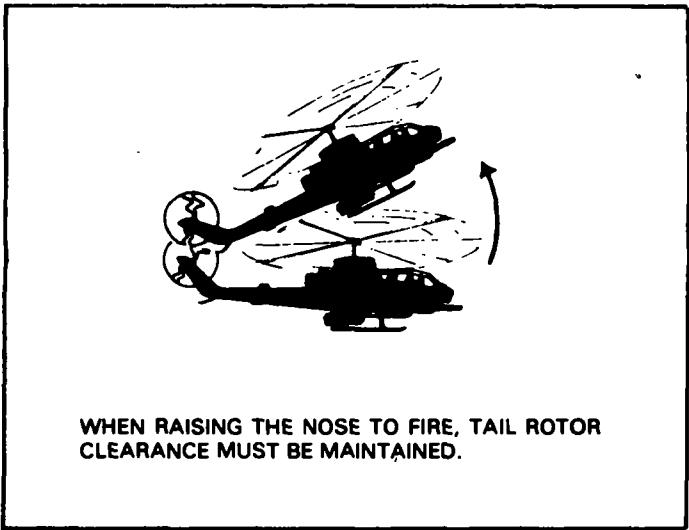


Figure E-7. Obstacle clearance

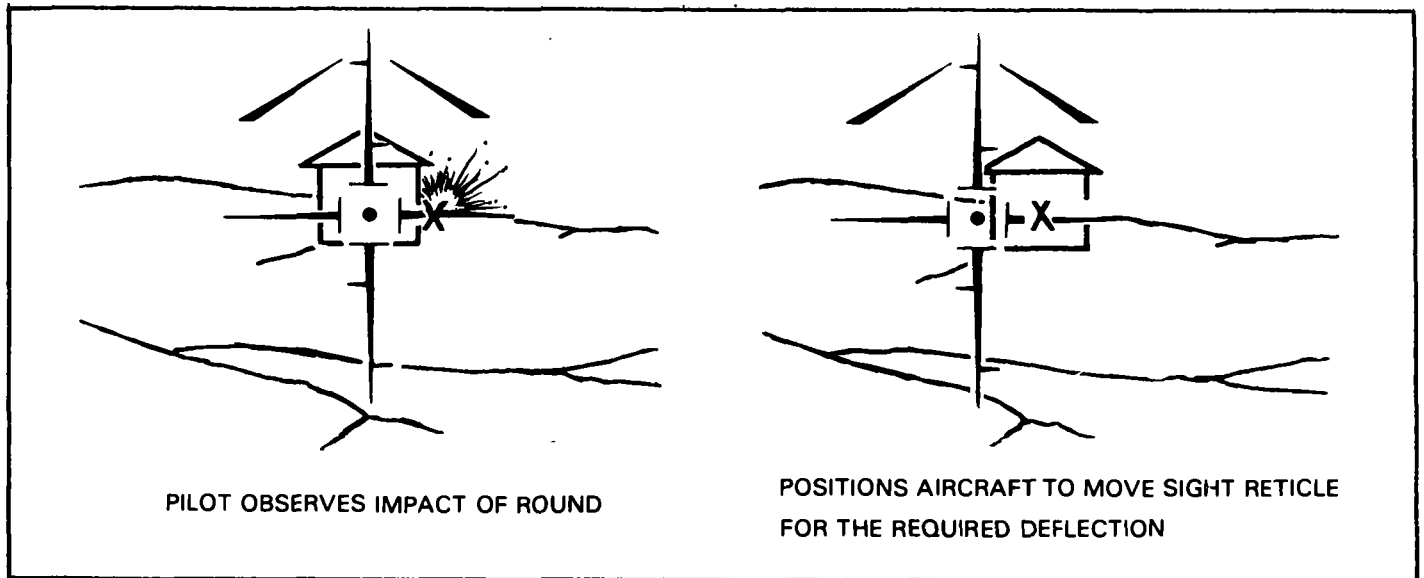


Figure E-8. Direct fire adjustment

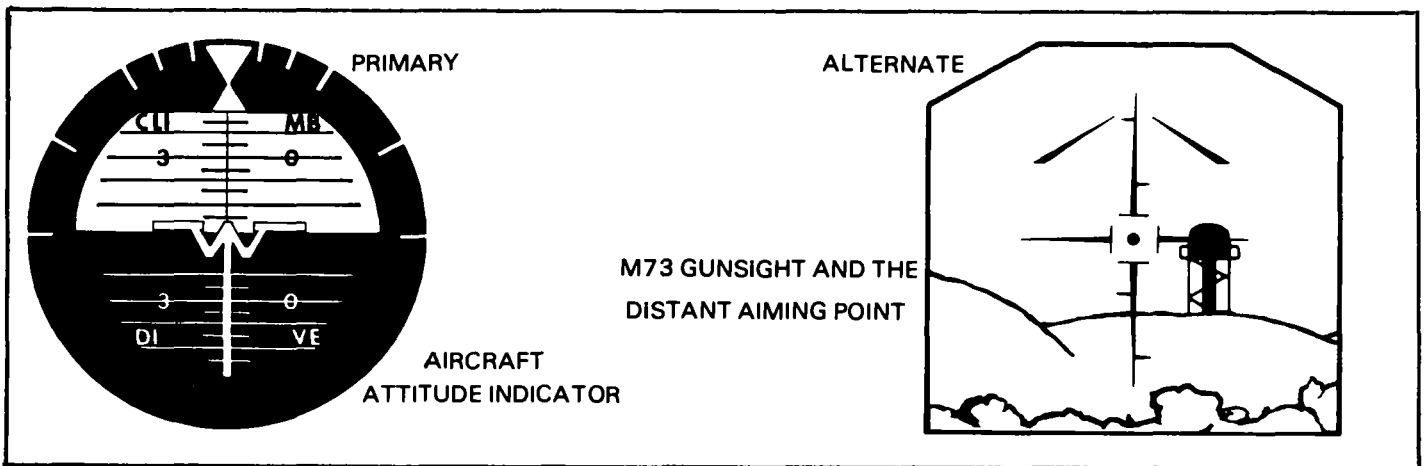


Figure E-9. Methods of determining pitch attitude

Table E-2. Attitude indicator tables

WHEN USING THE ATTITUDE INDICATOR, USE THESE TABLES.

INDIRECT RUNNING FIRE
DELIVERY AIRSPEED-60 KNOTS
LAUNCHER QE-150 MILS

DESIRED RANGE	PITCH ATTITUDE
3,500M	5°
4,500M	9°
4,950M	15°

INDIRECT HOVER FIRE
LAUNCHER QE-150 MILS

DESIRED RANGE	PITCH ATTITUDE
3,600M	0°
4,800M	5°
6,300M	10°

WHEN FIRING FROM A STABLE HOVER, A LAUNCHER
QE OF 126 MILS ACHIEVES A RANGE OF 3,049M;
A QE OF 150, A RANGE OF 3,608M.

(b) Drift adjustment. To determine the effects of wind drift on the helicopter, the pilot should make a trial run along the preselected approach to the firing point (Figure E-10). As the pilot flies the helicopter down the flight path and on the firing heading, he should observe for drift. If the helicopter drifts off course before reaching the firing point, the pilot should fly the approach again. He adjusts the flight path either left or right of the original flight path so that the helicopter crosses over the firing point aligned with the firing heading. This procedure compensates for drift without having to fly the helicopter out of trim. The flight maneuver required during the firing phase is the same as that discussed in direct running fire in paragraph *a(3)* above; however, the sighting technique is different. During the firing maneuver, the pilot must maintain the heading by referring to the heading indicator. Constant cross-check between the attitude and heading indicators is required. The weapons should not be fired until both instruments indicate the desired readings.

(c) Pitch attitude adjustment. When determining pitch attitude with the attitude indicator, the pilot may use either of two methods (Figure E-11). He may adjust the horizon bar the desired number of degrees above the miniature aircraft (Figure E-11, A). Then when over the firing point, he raises the nose of the helicopter until the miniature aircraft is level with the horizon bar and fires (Figure E-11, B). For the second method, the pilot levels the attitude

indicator (Figure E-11, C) for the desired airspeed, normally 60 knots. The pilot then raises the nose of the helicopter until the miniature aircraft indicates the desired number of degrees above the horizon bar and fires (Figure E-11, D).

NOTE: To achieve the desired range for the specific pitch attitude identified on the sight card, the attitude of the helicopter before beginning the pitch-up maneuver should be approximately 5 degrees nose-low. This attitude is typical for an attack helicopter flying at 60 knots with installed turret weapons. A higher or lower flight attitude results in the rocket's impacting beyond or short of the target.

(2) Indirect running fire using the gunsight.

(a) Firing point selection. A second sighting technique uses the M73 or M60 gunsight and a distant aiming point to conduct indirect running fire. This method is less accurate than other indirect delivery techniques, but it can be effective if an observer helps in adjusting fire on the target. For indirect fire, the aircrew must first select a firing point and determine the magnetic heading to the target (Figure E-12). The procedures used are the same as those discussed in paragraph *a(3)* above. After the range to the target is determined, the aircrew places the required mil setting on the mil scale of the gunsight (Figure E-13).

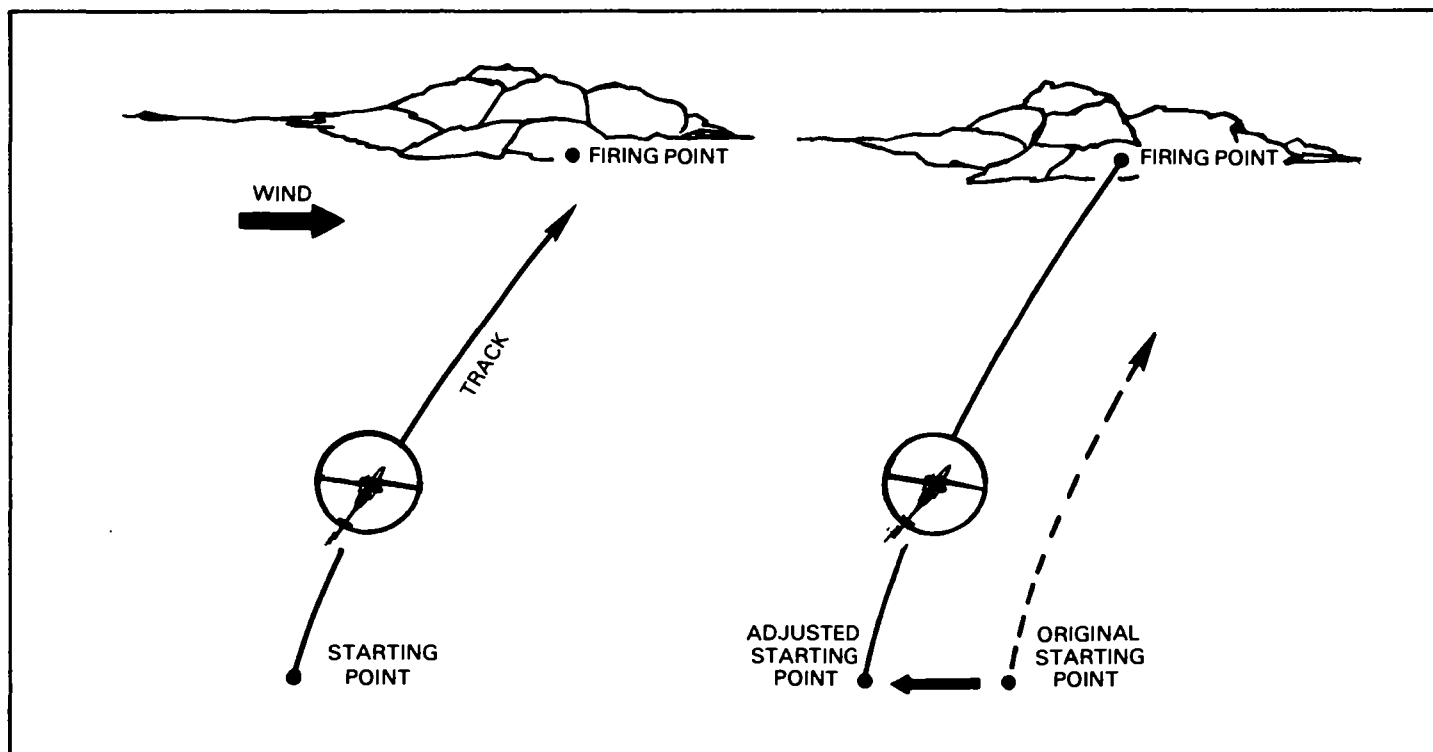
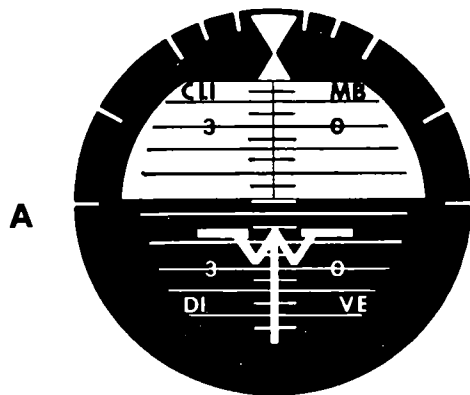
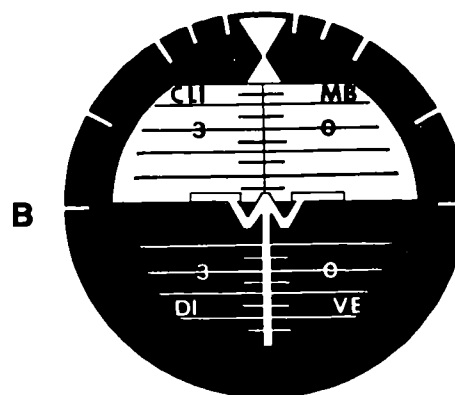


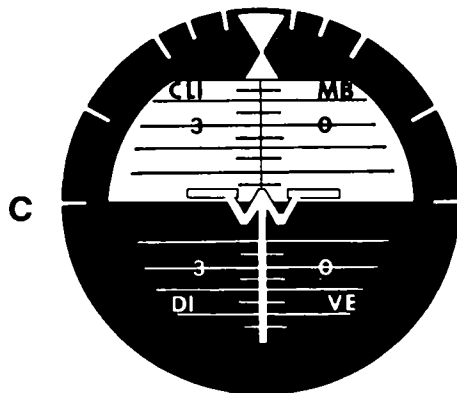
Figure E-10. Fire point selection and drift adjustment



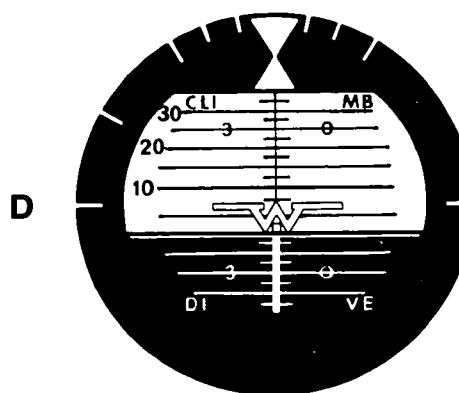
ADJUST THE HORIZON BAR ABOVE THE MINIATURE AIRCRAFT



RAISE THE NOSE AND FIRE

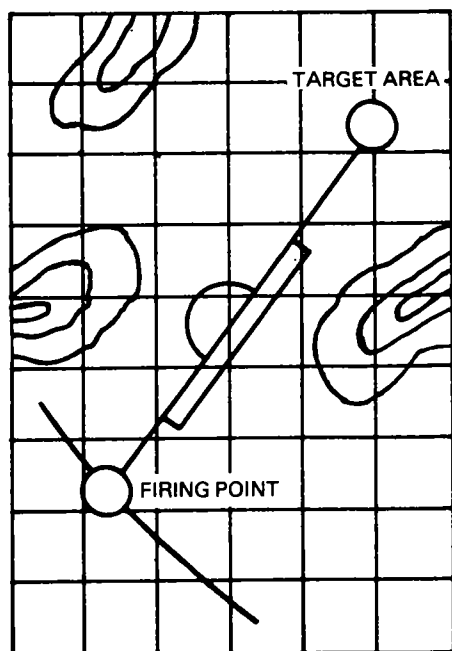


LEVEL THE ATTITUDE INDICATOR WHEN AT THE DESIRED AIRSPEED



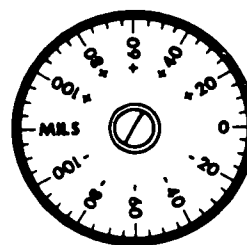
RAISE THE NOSE AND FIRE

Figure E-11. Determining pitch attitude



DETERMINE THE MAGNETIC HEADING TO THE TARGET

Figure E-12. Selection of firing point and determination of magnetic heading



MIL SCALE

Figure E-13. Gunsight mil setting

(b) Distant aiming point selection.

Before the first round is fired, a distant aiming point must be identified (Figure E-14). The pilot will use it as a reference for establishing the pitch attitude and adjusting for deflection on subsequent firings. Using the heading indicator, the pilot positions the helicopter over the firing point and aligns it with the target. When viewing through the M73 gunsight, the pilot selects a distant aiming point located between the firing point and the

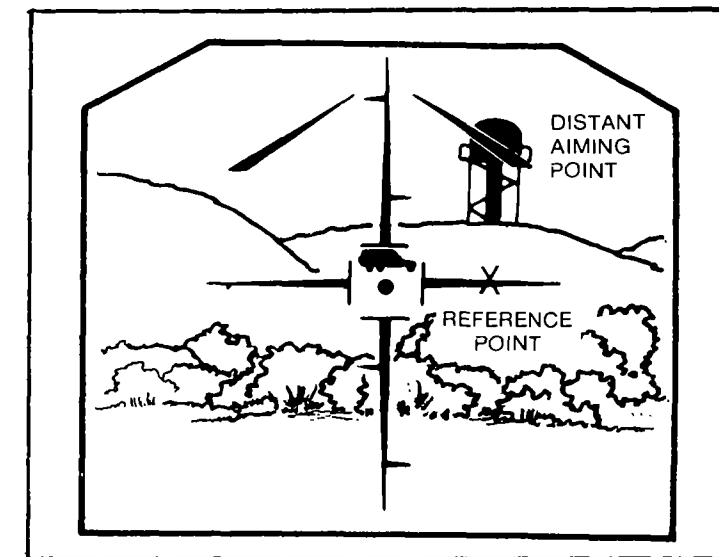


Figure E-14. Selection of distant aiming point

target. The distant aiming point must be located within the limits of the sight reticle and should be as close to the vertical cross hair as possible. It should be located at an elevation slightly higher than the firing point. The pilot marks a point on the horizontal cross hair of the sight reticle directly below the distant aiming point or makes a mental note of this position. For future discussions, this mark is referred to as the reference point.

(c) Target and heading alignment. The pitch-up maneuver is similar to that used in direct fire, except that the pilot sights on the distant aiming point rather than on the target. As the helicopter approaches the firing point (Figure E-15), the pilot uses the heading indicator

to maintain alignment with the target. When the distant aiming point comes into view through the gunsight, the pilot changes from the heading indicator to the gunsight to maintain heading alignment with the target. Heading is maintained by positioning the distant aiming point along an imaginary vertical line projected up from the reference point. During the pitch-up maneuver, the correct sight picture is attained when the distant aiming point is superimposed on the reference point (Figure E-16).

(3) Indirect hover fire. Indirect hover fire is conducted from a selected point on the ground. The aircrew must know the heading to the target and the approximate range. The procedures for selecting a firing point and determining the firing heading are the same as those discussed in paragraph *a(3)* above. Both sighting techniques, attitude indicator and gunsight, for indirect running fire can be used for indirect hover fire. Table E-3 shows pitch attitude for indirect firing for a QE of 126 mils. When the prefiring procedures have been completed, the pilot aligns the helicopter with the target at a stabilized hover using the heading indicator or the distant aiming point. The pitch-up maneuver is initiated by applying aft cyclic, while collective pitch is added to keep the tail rotor clear of obstacles. The techniques discussed in paragraph *a(4)* above on direct hover fire can also be used. The desired pitch attitude is indicated either by the miniature aircraft's position on the horizon bar or when the gunsight's horizontal cross hair aligns with the distant aiming point. The pilot must anticipate the effect of tuck and the rearward movement of the helicopter when the rocket is fired (Figure E-17).

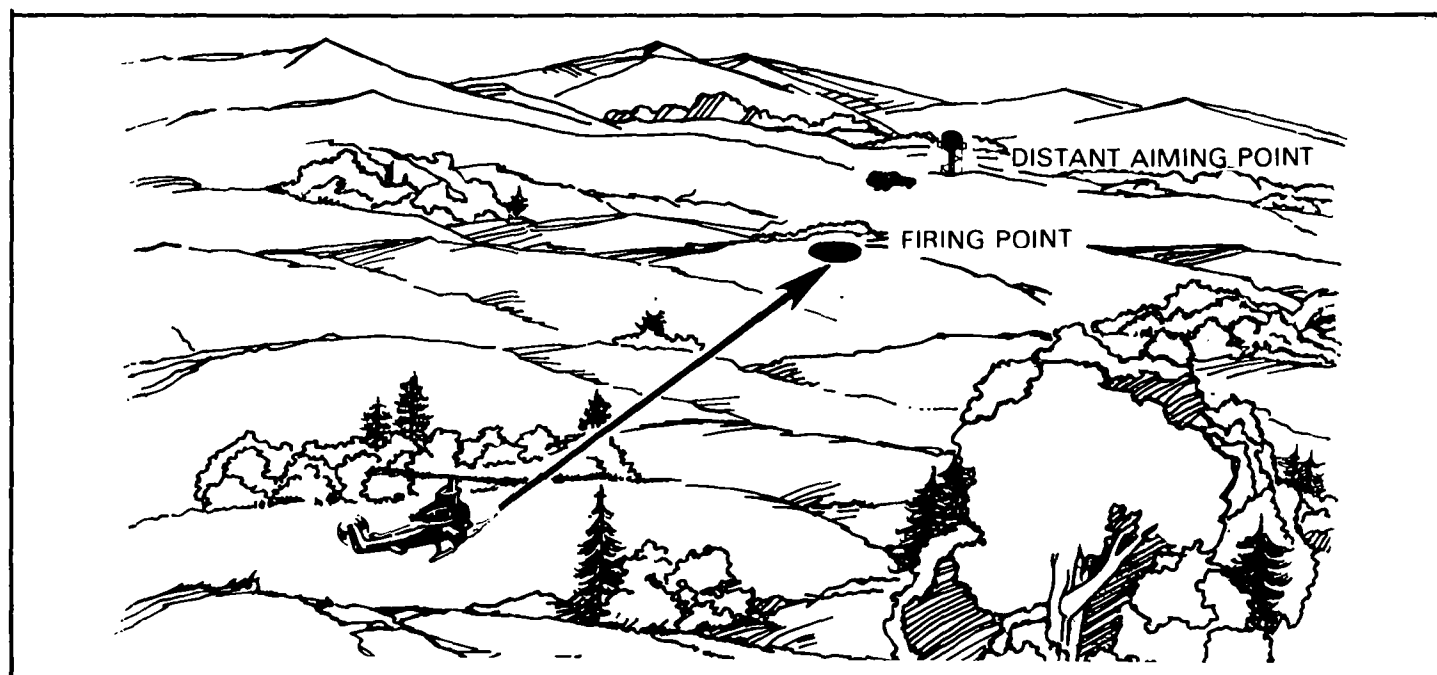
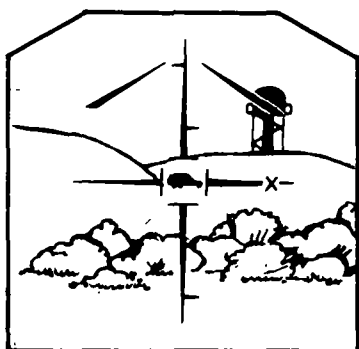
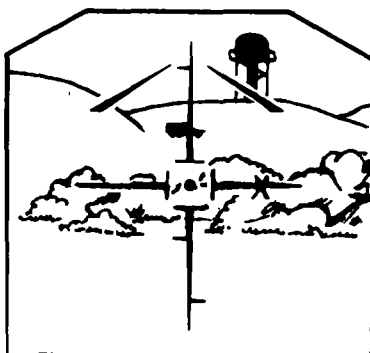


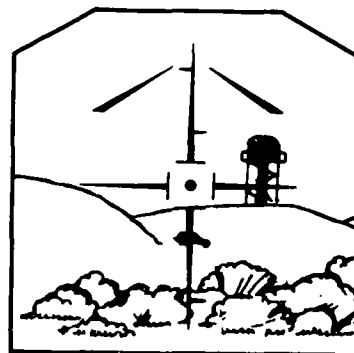
Figure E-15. Approach to firing point



1. VIEW AS HELICOPTER APPROACHES FIRING POINT

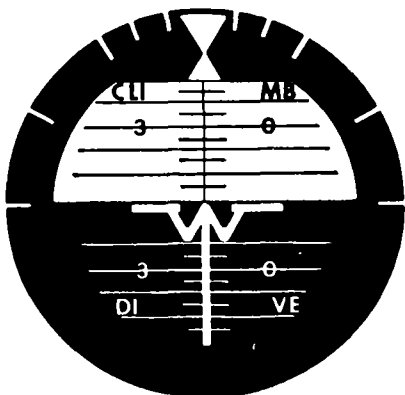


2. VIEW WHEN BEGINNING PITCH-UP MANEUVER

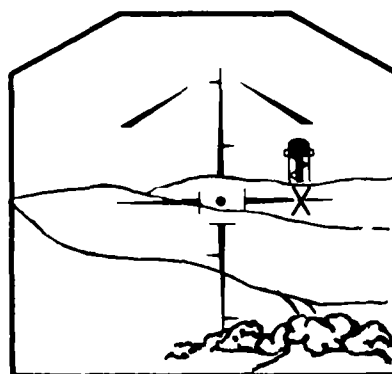


3. VIEW TO FIRE

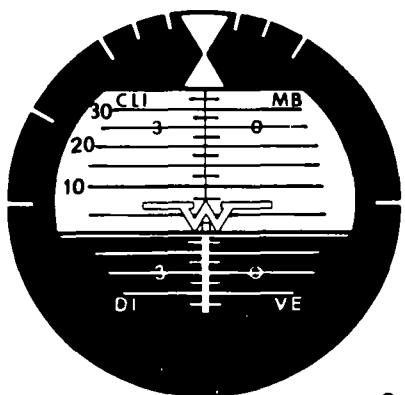
Figure E-16. Correct sight picture



1. LEVEL THE ATTITUDE INDICATOR



2. MARK THE REFERENCE POINT



3. PITCH UP AND FIRE

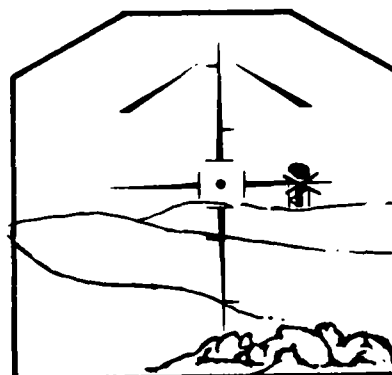


Figure E-17. Firing technique—indirect hover fire

NOTE: The rocking chair method described in paragraph D-8c is a stable and safe delivery procedure.

(4) Stable fire. The stable fire technique used in indirect hover delivery does not require a helicopter attitude change to fire weapons. With

this delivery technique only one range can be fired. During premission planning, the QE on the launchers should be set for the most desired range. To engage a target accurately, a firing point must be selected at a distance from the target equal to the range compatible with the QE setting on the launcher. The procedures for determining the firing

Table E-3. Indirect hover fire (QE 126 mils)

<u>RANGE (Meters)</u>	<u>PITCH ATTITUDE (Degrees)¹</u>	<u>TIME OF FLIGHT (Seconds)</u>	<u>MAXIMUM TRAJECTORY HEIGHT (Feet)</u>	<u>MAXIMUM TRAJECTORY RANGE (Meters)²</u>
1,500	-5	3.7	45	764
2,000	-4	5.1	80	1,000
2,500	-3	6.5	150	1,400
3,000	-2	8.4	260	1,700
3,500	-1	10.5	455	1,995
4,000	+1	12.5	608	2,220
4,500	+3	15.2	905	2,535
5,000	+5	18.6	1,378	3,050
5,500	+9	22.0	1,764	3,156
6,000	+13	26.0	2,788	3,600
6,500	+18	31.0	3,908	3,951.2

¹One bar width equals 2 degrees.

²The range at which the rocket will reach the maximum trajectory height.

heading are the same as those discussed for running fire, except the target cannot be seen from the firing point. When the target is to be engaged, the pilot establishes a stabilized hover over the firing point and aligns the helicopter with the target by referring to the heading indicator. The target is engaged from the hover attitude. While the pilot maintains a stabilized firing attitude, large volumes of fire can be placed on the target.

(5) Indirect fire adjustment.

(a) *Corrections using the dead-reckoning computer.* Corrections to adjust for indirect fire must be received from an observer. After receiving the observer's corrections, right

400, add 200 (Figure E-18), the aircrew must convert these corrections into the aircrew corrections with the dead-reckoning computer. The aircrew then determines the elevation and deflection required to hit the target. For example, the aircrew correction is computed to be right 100, add 400. The range to the target is about 3,500 meters. Using the rule for range adjustment previously discussed, the pilot adds a +20-mil correction to increase the impact point of the rocket 400 meters. This correction is applied to the mil scale on the gunsight. The aircrew should use the slide rule of the dead-reckoning computer to determine the deflection correction and arrive at a lateral correction of 29 mils to the right. This correction is either marked on the horizontal cross hair of the sight reticle or mentally

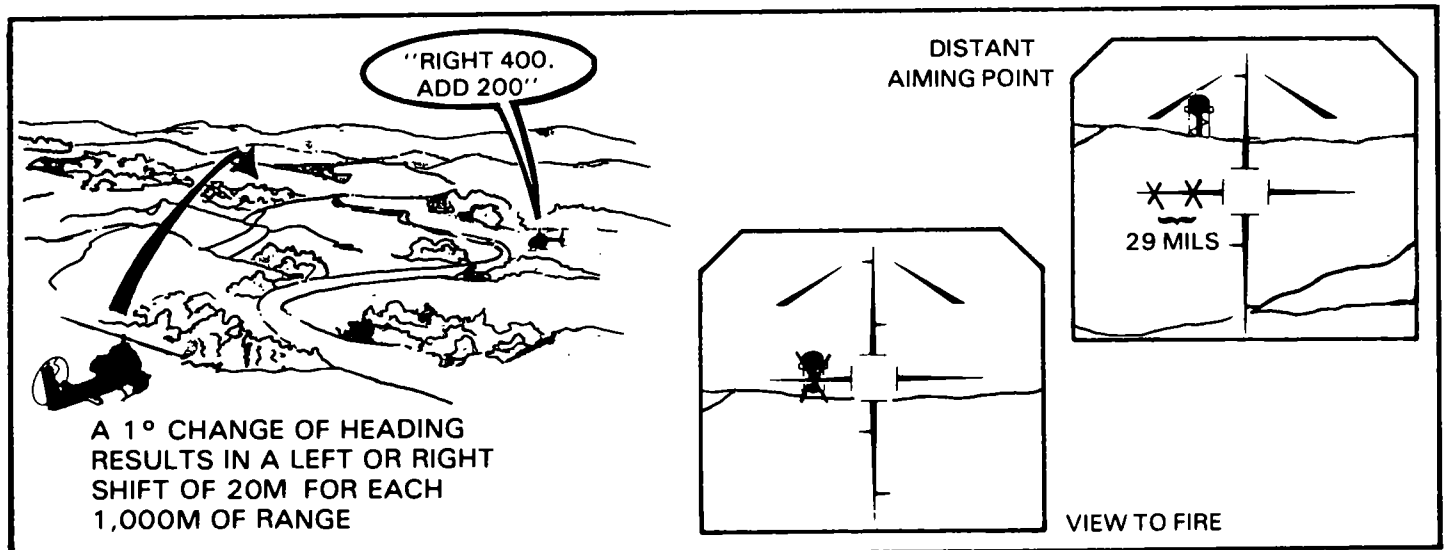


Figure E-18. Distant aiming point

noted. The correction is marked 29 mils left of the previous mark. When the new reference mark is superimposed on the distant aiming point, the elevation and deflection corrections required to hit the target have been applied. Subsequent lateral adjustments are made from the new reference mark.

(b) Corrections using the attitude indicator. Indirect fire range can also be adjusted with the attitude indicator. For example, after receiving the observer's corrections, the aircrew's correction is determined to be right 100, add 800. The range to the target is 3,500 meters. The unit of measurement for range adjustment is degrees. Assuming that 1 degree increases or decreases the range of the rocket 350 meters, the pilot must increase the pitch attitude 2 degrees (about one bar width on the attitude indicator). The scale on the attitude indicator cannot be read accurately; therefore, adjustments of less than 1 degree (350 meters) cannot be made. Another way to adjust for range is to move the helicopter closer or farther from the initial firing point. This will be the distance required to correct for the range error and to fire using the same pitch attitude. To determine the deflection correction, the rule of thumb is that a 1-degree heading change moves the impact point of the rocket about 20 meters at 1,000 meters. In Figure E-18, it is determined that 1 degree moves the impact point 70 meters (20 x 3.5). A pitch or heading change of 1 degree will move the impact as shown in Table E-4.

c. Diving Fire Delivery Technique. The M73 sight can be set for diving fire with the combat sight setting. This method requires little mathematical and manual manipulation. It allows targets to be engaged over widely varying ranges

without the sight being adjusted. For a combat sight, the aircraft systems must first be bore-sighted according to the appropriate manual. A target is then selected at a range from which the majority of the targets will be engaged. This range may be made according to individual preference or the unit SOP. One round is fired at a tactical attitude and airspeed and with the piper on the target. The impact of the round is then noted, and the knurled ring of the sight's ELEVATION/DEPRESSION knob is rotated to put the piper on the burst. The above two steps are repeated until the rounds are consistently hitting where the piper is pointing. Usually, three rockets are sufficient to obtain the combat sight setting. For example, the pilot flies at 2,000 feet AGL with a power setting of 25 pounds (50 percent) torque. When the appropriate slant angle (for example, 30 degrees) is reached, he noses the aircraft over to put the piper on the target. When the aircraft passes through 1,600 feet AGL and 120 knots, one rocket is fired. While the pilot holds the aircraft on the same dive angle at the same power setting, the knurled knob on the M73 sight is rotated to place the piper on the point of impact. Using the same criteria, the maneuver is repeated to validate the combat sight setting. Changes in range are accomplished by aiming 4 mils high for every 100 meters the impact was over the target and vice versa.

NOTE: The combat sight setting for the turret gun is usually accomplished at slightly less than maximum effective range.

E-4. FIRING THE M197, 20-MILLIMETER CANNON

a. The modes of operation for the M97 turret on this aircraft are basically the same as those for the

Table E-4. Indirect hover fire chart (126-mil setting)

1° PITCH ELEVATION/DEPRESSION (Meters)	RANGE TO TARGET (Meters)	1° AZIMUTH DEFLECTION (Meters)
100	6,500	130
125	6,000	120
160	5,500	110
200	5,000	100
250	4,500	90
290	4,000	80
350	3,500	70
400	3,000	60
500	2,500	50
680	2,000	40
800	1,500	30
1,000	1,000	20

AH-1S(MC). Operating procedures for the M97 are also found in TM 55-1520-236-10.

b. The AH-1S(ECAS) does not have a TSU/GUN SLEW RATE switch. When the TSU/GUN mode is being used and the LO MAG position is selected, the turret and TSU will slew at 70 degrees per second in azimuth and 45 degrees per second in elevation. When the HI MAG position is selected, it will slew at 27.5 degrees per second in azimuth and 22 degrees per second in elevation. The ECAS does not have the laser range finder for the TSU/GUN mode.

NOTE: When the turret is fired in the flex mode, the DEPRESSION LIMIT switch should remain activated, when possible, to avoid inadvertent shrapnel damage to the aircraft.

E-5. FIRING WEAPONS SIMULTANEOUSLY

When the action switch is pressed to fire rockets or the TOW and the turret is slewed greater than 5 degrees in azimuth, the wing stores lockout circuitry is activated. The turret will stow to zero degrees in azimuth and elevation to preclude the possibility of a turret round detonating the rockets or missile near the helicopter. The 20-millimeter can be fired simultaneously with either the rockets or the TOW. Rockets and the TOW can also be fired simultaneously. The pilot must stay within TOW constraints when firing the rockets; he must ensure the rockets do not interfere with the missile or missile guidance wires.

FIRING WEAPON SYSTEMS OF THE AH-1S(MOD) AND AH-1S(PROD)

The AH-1S(MOD) and the AH-1S(PROD) are the first AH-1 models to have the capability of firing the TOW. Other features of these helicopters include the M28E1 turret, which fires either 7.62-millimeter or 40-millimeter weapon systems, and the 2.75-inch FFAR. Procedures for firing these weapon systems are discussed in this appendix.

F-1. SYSTEMS

a. M73 Reflex Sight. The M73 reflex sight is used when the 2.75-inch FFAR is fired in the direct mode. It is also used when the 20-millimeter cannon is fired in the fixed position.

b. Helmet Sight Subsystem. With the helmet sight subsystem, the pilot or gunner can acquire visible targets rapidly. For a description of this subsystem, see paragraph D-9.

c. M65 TOW System. The description is in paragraph D-4. In the AH-1S(MOD), the TOW system has the following differences:

(1) The system has a missile status panel that gives a visual display of the missile that has been selected for firing and the launchers that have missiles remaining. The WIRE CUT switch is located on this panel instead of on the collective.

(2) The PHS ACQ button is located on the sight hand control. For the gunner to acquire a target in the TSU from the pilot, the gunner must move the ACQ-TRK-STOW switch to the TRK position and push the PHS ACQ button.

d. M28E1 Turret. The turret is hydraulically powered and electrically operated. The pilot can fire it in the fixed or flexible mode, and the gunner can fire it in the flexible mode. The turret travel limits are 107.5 degrees left or right of center in azimuth and 50 degrees in depression; elevation varies from 12 degrees to 17.5 degrees.

NOTE: When the turret is fired in the flex mode, the DEPRESSION LIMIT switch should remain activated, when possible, to avoid inadvertent shrapnel damage to the aircraft.

e. M134, 7.62-Millimeter Minigun. This gun is an electrically driven, automatic, air-cooled, six-barrel weapon. It is capable of firing six-second bursts at either 2,000 or 4,000 rounds per minute.

WARNING

Firing duration of the M134 minigun is controlled by a burst-limiting relay that automatically deactivates the weapon after six seconds. Following a six-second burst of the machine gun, the firing trigger *is not* reactivated until the weapon has been allowed to cool. In hover, a six-second burst is followed by a 10-second cooling period. In normal flight, a six-second burst is followed by a five-second cooling period.

(1) The range of the weapon depends on the delivery technique and the desired effect on the target. The maximum effective range of the system is 1,100 meters. This range is about 200 meters beyond tracer burnout. Accurate adjustment can be made to place effective fire on the target after tracer burnout by estimating trajectory impact and burst on target effect. When the weapon is fired with the aircraft in hover and the turret in maximum elevation, maximum ranges up to 2,500 meters can be achieved. The low impact velocity of the projectile causes the accuracy at maximum range to be poor and lessens the target effect.

(2) When the M28 turret contains only one minigun, it should be mounted on the right side of the turret. This procedure aids the ammunition-feeding mechanism by providing gravity-assist. Only ammunition designated for the M134 minigun should be used. Although regular M60 machine gun ammunition can be fired with the M134 minigun, the link is weaker than that in the M134. When M60 machine gun ammunition is fired in the M28 armament system, the link is subject to breaking.

f. M129, 40-Millimeter Grenade Launcher. The launcher is an electrically driven, air-cooled weapon capable of firing a 10-second burst at

400 grenades per minute. Because it is accurate at short ranges, the system is especially adaptable to terrain flight firing. It also provides excellent suppressive fire and has a flex capability. With the flex capability, the aircrew can suppress enemy positions without overflying the target.

(1) The muzzle velocity of this projectile is relatively slow. When targets are engaged at ranges beyond 500 meters, the helicopter must unmask for a long time to adjust fire on the target accurately. When adjusting fire, the aircrew usually estimates range to the target inaccurately. If the aircrew knows the correct range, the probability of a first-round hit is good up to 1,600 meters.

(2) The dispersion of the weapon system is good. For point targets, a 20-meter square will contain approximately 50 percent of the rounds when it is fired at targets up to 1,600 meters. The maximum range the weapon can achieve with running fire is 1,600 meters. When the weapon is fired from a hover, targets can be engaged up to 2,000 meters. These ranges may be less, based on turret loading.

F-2. FIRING THE TOW

Operational procedures are the same as those for the AH-1S(ECAS). They are described in paragraph E-2.

F-3. FIRING THE 2.75-INCH FFAR

Operational procedures are the same as those for the AH-1S(ECAS). There is no rocket management system on the AH-1S(MOD) and (PROD). The procedures for firing this rocket are described in paragraph E-3.

NOTE: For the AH-1S(MOD) and AH-1S(PROD), the standard turret configuration for computing the sight card is 2,000 rounds of 7.62-millimeter ammunition and 125 rounds of 40-millimeter ammunition (one-half of a turret load). The weight of ammunition stored in the turret affects the range so that it differs from that shown on the sight card. The larger the quantity of ammunition, the shorter the range; the smaller the quantity of ammunition, the longer the range.

F-4. FIRING THE TURRET

a. There are no delivery techniques for terrain flight peculiar to the M134 minigun. The normal

aiming of the gun is accomplished by superimposing a reticle image on the target for the appropriate range.

b. When the grenade launcher is fired from terrain flight altitudes, greater accuracy can be achieved with hover fire and by limiting turret movement to 15 degrees either side of center position. This delivery technique minimizes the yaw and tuck effects encountered when the grenade launcher is fired at greater deflection angles. Increased ranges can be achieved by firing the grenade launcher in the stowed mode and by adjusting the pitch attitude of the aircraft to obtain the desired range. Normal aiming of the grenade launcher is accomplished by superimposing a reticle image on the target for the appropriate range.

NOTE: The procedures for using the HSS and TSU modes are virtually the same as those for the AH-1S(ECAS). The position of the ATS switch is important.

F-5. FIRING SYSTEMS SIMULTANEOUSLY

a. *Simultaneous Turret Weapon Fire.* The turret can contain either two miniguns, two grenade launchers, or one minigun and one grenade launcher. When the turret contains like weapons, both weapons may be fired at the same time. When the turret contains one minigun and one grenade launcher and the gunner's select switch is in the BOTH position, only the minigun will fire.

b. *Simultaneous Turret and Wing Store Fire.* When the wing stores are being fired, the turret is interrupted for approximately 1.5 seconds after the wing store's firing button has been released. The different modes for firing are found in TM 55-1520-236-10. If the fast rate of fire is used in firing turret weapons, the TSU will vibrate during missile engagement. If the turret must be fired, a slower rate of fire will lessen this vibration. The slower rate of fire increases the probability of the weapon jamming.

c. *Simultaneous Rocket and TOW Fire.* To simultaneously fire rockets and the TOW, the pilot must keep the aircraft within TOW constraint limits. He must also ensure the rocket does not affect the TOW or the TOW guidance wires.

FIRING WEAPON SYSTEMS OF THE AH-1G

The AH-1G is equipped with the M134, 7.62-millimeter minigun; M129, 40-millimeter grenade launcher; M35, 20-millimeter cannon; and 2.75-inch FFAR. While it is scarce in most active duty units, the AH-1G is the primary aircraft in many reserve and NG units. This appendix discusses the capabilities and limitations of the AH-1G weapon systems.

G-1. SYSTEMS

a. M73 Reflex Sight. The M73 reflex sight is used when the 2.75-inch FFAR is fired in the direct mode. It is also used when the 20-millimeter cannon is fired in the fixed position.

b. M28E1 Turret. The system is the same as that of the AH-1S(PROD), described in paragraph F-1d, except for the sighting station. The sighting station provides a means for the gunner to aim and fire the weapons. The weapon is aimed by superimposing a reticle image on the target. There are two sighting techniques (Figures G-1 and G-2) that can be used when turret weapons are fired on the AH-1G. The first technique is to place the gunsight reticle on the target with the appropriate range line on the target. When

this technique is used, the range adjust control must be positioned to 1,200 meters (Figure G-1). The second procedure is to place the gunsight reticle center dot, located at the intersection of the horizontal and vertical cross hairs, on the target. When this technique is used, the estimated range to the target must be placed on the index of the range adjust control (Figure G-2). Displacement of the vertical cross hairs left or right of the target to compensate for lateral error is not required when the COMP switch is in the IN position.

NOTE: When firing the turret in the flex mode, the depression limit switch should remain activated, when possible, to avoid inadvertent shrapnel damage to the aircraft.

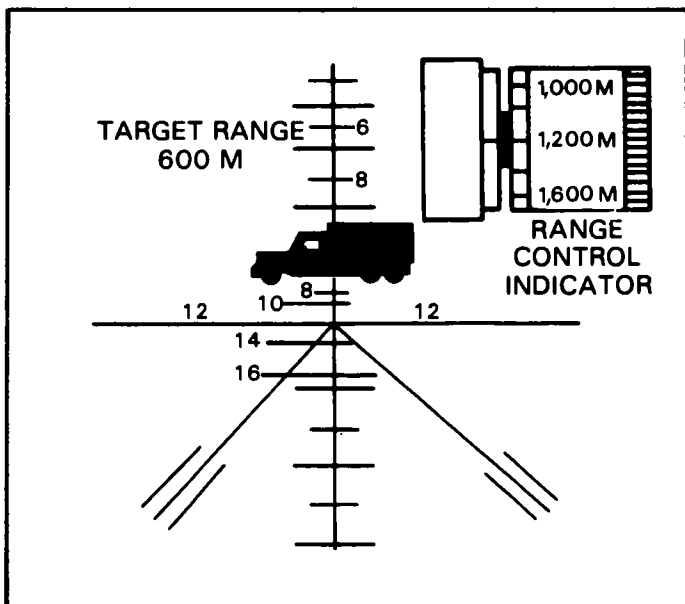


Figure G-1. Technique 1—range line on target

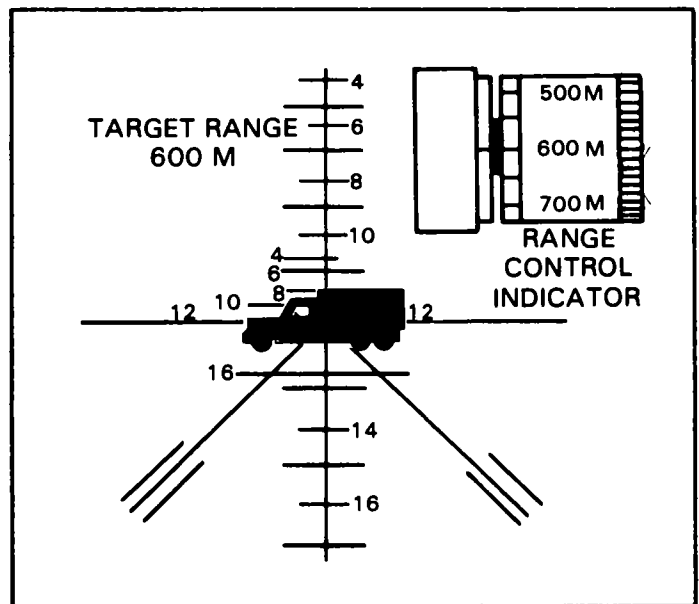


Figure G-2. Technique 2—reticle on target

c. **M134, 7.62-Millimeter Minigun.** This gun is an electrically driven, automatic, air-cooled, six-barrel weapon. It is capable of firing six-second bursts at either 2,000 or 4,000 rounds per minute.

d. **M129, 40-Millimeter Grenade Launcher.** This launcher is an electrically driven, air-cooled weapon capable of firing a 10-second burst at 400 grenades per minute. For a further description of this launcher, refer to paragraph F-1f.

e. **M35, 20-Millimeter Cannon.**

(1) **Capabilities.** With the firepower of the 20-millimeter cannon (Figure G-3), attack helicopter aircrews have a standoff capability against enemy small arms and some anti-aircraft weapons. The high muzzle velocity and rate of fire enable the aircrew to place large volumes of accurate fire on the target in the minimum amount of exposure time. With the cannon's improved projectile fuzing, the aircrew has a greater capability for tactical operations in a high-threat environment.

(2) **Limitations.**

(a) This weapon system is limited by several factors that will prevent the fuze from functioning properly. The existing fuze mechanism for the 20-millimeter projectile is a point-detonating type that requires a high-impact force to cause detonation. Even when the weapon is fired within its effective range, low angles of impact may cause the round to ricochet rather than detonate. This is critical when the 20-millimeter is fired from NOE altitudes. Regardless of the range, the fuze's functioning is directly affected by the type of target that is being engaged. Projectiles that strike hard,

flat surfaces—such as buildings and armor vehicles—have a higher probability of detonation than those that strike soft targets.

(b) Structural damage from the recoil of the weapon system is common. When the 20-millimeter cannon has been fired, the wing stores mounting brackets should be inspected before and after each mission. The 20-millimeter cannon produces a large muzzle flash. When it is fired at night, it is easily recognizable and may cause the aircrews to lose their night vision. If the 20-millimeter cannon is fired when the aircraft is at a hover, carbon is expelled and is sucked into the engine inlet, causing loss of power.

(3) **M35 sight card.** To achieve the greatest accuracy when the sight card is used, the aircrew should compute the ballistic correction for the weapon by firing the weapon and applying the correction to the mil setting for the desired range. The loading configuration of the helicopter for computing the sight card is based on a one-half turret load of ammunition. The quadrant elevation of the gun must be set at +84 mils when the sight card is used. Based on these conditions, a range of 1,500 meters is achieved when the M35 is fired from an aircraft in a stabilized hover. Targets that are engaged beyond or short of their range require a pitch attitude change to hit the target. When fired from an aircraft in a stabilized hover, a projectile's range to impact can be adjusted by changing the QE of the gun. For example, by adding +18 mils ($84 + 18 = 102$ mils) to the QE, a range of 2,000 meters can be achieved. If a target is to be engaged at another range with the gun set at 102 mils, 18 mils must be either added or

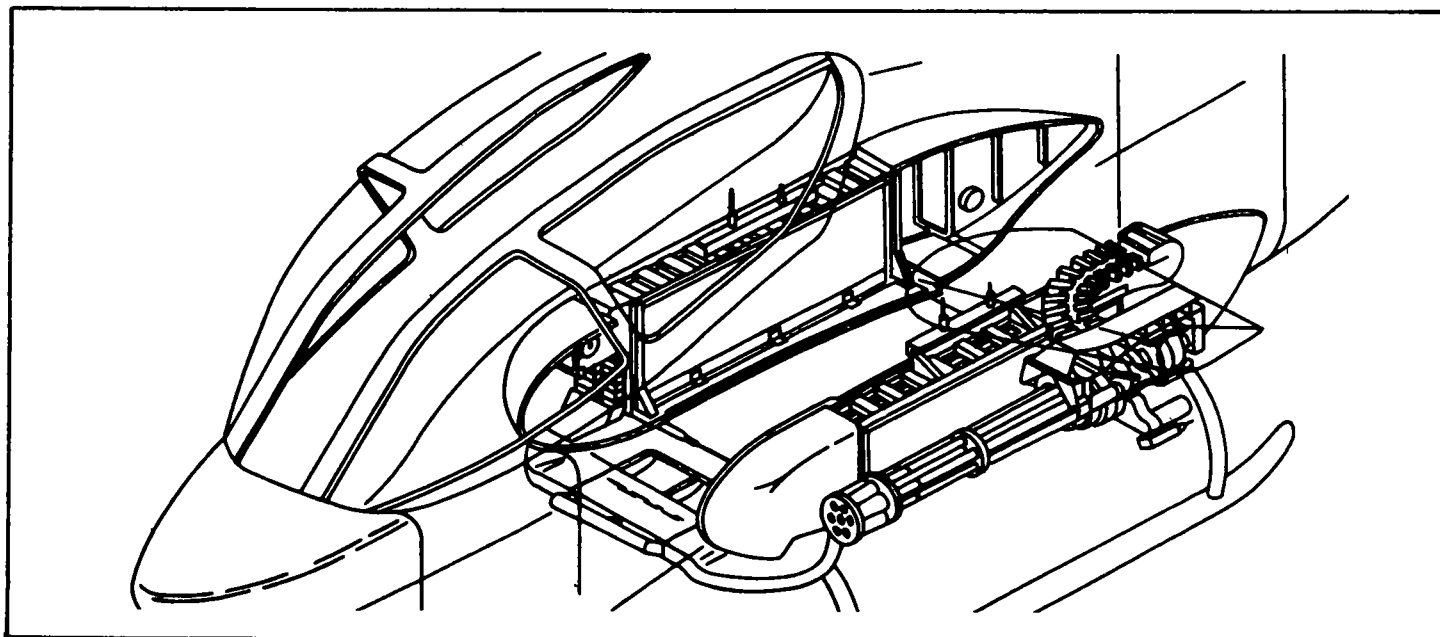


Figure G-3. M35, 20-millimeter cannon

subtracted (depending on the range to the target from the mil setting on the sight card) or a new sight card must be developed for the new QE setting on the gun. Table G-1 shows mil settings for the M35 gun at various ranges.

Table G-1. Range and mil settings for the M35 gun	
RANGE (Meters)	SETTING (Mils)
500	-30
1,000	-18
1,250	-9
1,500	+ 0
2,000	+18
2,500	+39
3,000	+95

G-2. FIRING THE 2.75-INCH FFAR

Operational procedures are the same as those for the AH-1S(ECAS). There is no rocket management system on the AH-1G. The procedures for firing the rocket are described in paragraph E-3.

G-3. FIRING THE TURRET

a. The procedures for firing the turret are the same as those for the AH-1S(PROD), described in paragraph F-4, with the exception of the sighting station. The sighting station requires a different delivery technique.

b. When firing tracer munitions, the gunner initially aims the weapon with the gunsight. After the initial burst impacts, the gunner should move his head away from the gunsight. He then visually adjusts fire on the target using tracers and burst-on-target effect to bring the point of impact on the target. The gunsight restricts the gunner's ability to observe the tracer and degrades his depth perception. The gunner can visually adjust tracers to more accurately and quickly place effective fire on the target.

G-4. FIRING THE M35, 20-MILLIMETER CANNON

The aircrew's ability to place effective fire on the

target with minimum expenditure of ammunition in the least amount of time depends on several factors. These factors are accuracy of the boresight, combat sight setting for diving fire or ballistic correction for terrain firing, and range estimation. Initial engagement of a target for diving fire and terrain firing is the same as previously discussed in paragraph E-3. Subsequent adjustments to place the projectile onto the target are accomplished by using the walk-on method. Up to 1,500 meters, tracer fire provides the best method of walking the projectile onto the target.

a. To use tracers to adjust, the helicopter must be on higher ground shooting down or the engagement range must be short enough for the trajectory to be below the horizon. The use of tracers to adjust fire discloses the helicopter's position to the enemy. At ranges greater than 1,500 meters, BOT provides the aircrew the best means of adjusting the projectile onto the target. As range increases, adjustment becomes more difficult because of the probability of fuze malfunction.

b. Greater accuracy is achieved when the 20-millimeter cannon is fired with direct fire delivery techniques during running fire. Airspeed above 40 knots provides a more stable platform for firing. However, airspeeds between 110 and 120 knots should be avoided. When the aircraft is moving between these airspeeds, a yawing effect is experienced. This is caused by excessive antitorque inputs at the same time the cambered vertical fin begins to develop effective heading control.

c. The 20-millimeter cannon can be effectively employed to engage targets while the aircraft is at a hover. A yaw to the left must be anticipated and sufficient antitorque pressures applied to align the gunsight on the target.

G-5. FIRING WEAPONS SIMULTANEOUSLY

When the action switch is pressed to fire rockets, the turret will stop firing momentarily until the rockets have launched. When the 20-millimeter cannon is being fired, the turret will continue to fire. Rockets and the 20-millimeter cannon *cannot* be fired simultaneously.

UH-1B, UH-1C, AND UH-1M WEAPON SYSTEMS AND SUBSYSTEMS

The UH-1B, UH-1C, and UH-1M helicopters are equipped with three main weapon systems. These are the M22 antitank guided missile subsystem, the M5 40-millimeter rifled-bore grenade launcher, and the M21 armament subsystem.

H-1. M22 ANTITANK GUIDED MISSILE SUBSYSTEM

The M22 is a helicopter-mounted missile armament subsystem. The gunner fires, controls, and guides each missile by operating an airplane-type control stick to signal the missile in pitch and yaw commands. These directional commands are transmitted to the in-flight missile through two guidance wires that play out from spool assemblies inside the missile. Command impulses are decoded inside the missile and routed to its flight control devices. Although the M22 subsystem is primarily an antitank weapon, it is also effective against gun emplacements, roadblocks, fortifications, and similar targets. It is responsive and highly mobile and may be employed with air and ground maneuver elements.

a. The subsystem's six missiles can be fired from a hover between 500 and 2,900 meters or in forward flight between 500 and 3,500 meters. The daily rate of fire is limited only by ammunition resupply and possible time-compliance part changes or maintenance. The M22 subsystem is vulnerable to all types of air defense fires, including small arms. Operational limitations are as follows:

- The helicopter must be exposed to the target from launch to impact since the missile is guided by the gunner's line-of-sight vision.
- Only one missile can be fired at a time.
- Operational effectiveness is reduced at night and during periods of low visibility.
- Use of the M55 binocular sight requires that the helicopter be equipped with yaw stabilization (AN/ASW-12). However, the XM58 sight does not require yaw stabilization.

b. Each missile is shipped as a complete round of ammunition in an individual shipping container. The missile's two major components are its warhead and missile body. Missile bodies are different for each missile. For firing, the warheads screw onto the fuze body neck at the front of the missile body. The rear edge of the warhead enters the front end of the missile body when the missile is completely assembled. The two warheads are the inert and the HEAT. The ATM-22B training missile has an inert warhead. It contains a red, nonexplosive marking powder as well as the weights needed for ballast. The AGM-22B missile has a 140-millimeter, 3 1/2-pound shaped charge, HEAT warhead.

CAUTION

Although the warheads are alike except for color coding, they cannot be interchanged on the AGM-22B and ATM-22B missiles. The tactical round has a fuze and detonator in the missile body, but the training round does not have a detonator.

c. The target may be engaged at any range between 500 and 3,500 meters. The maximum range depends on the mode in which the missile is fired. Tactical as well as terrain considerations dictate the range at which the target will be engaged. The size and silhouette of the target determine the angle of fire. The gunner's consideration is whether to use the antioscillation sight.

(1) The difficulties of target acquisition and firing without the sight increase with range. When

the gunner fires with the naked eye, the pilot need not remain on an inbound course after launch. Instead, he can take small evasive maneuvers in both the lateral and vertical planes. The gunner must keep missile flares between him and the target. Evasive maneuvers, however small, will increase the gunner's difficulty in accomplishing this task. This is because the gunner's angle of vision will change with each deviation from a collision course.

(2) A disadvantage of firing with the naked eye is that the gunner has an unclear view of the target because of the range. When the edges of the target are poorly defined, the center of mass is hard to determine. Therefore, the gunner has trouble placing missile flares in the middle of the target area. This often results in near misses, either laterally or vertically. Also, when the gunner fires at targets beyond 2,500 meters without a magnified view of the target and missile, the smoke from the missile sustainer motor may obscure both the missile flares and the target. The method of firing is as follows:

(a) Estimate missile flight time to target. Table H-1 shows missile flight time to target.

Table H-1. Missile flight time to target	
TARGET RANGE (METERS)	MISSILE FLIGHT TIME (SECONDS)
500	5
1,000	9
1,500	12
2,000	15
2,500	18
2,900	20

(b) Launch the missile and then initiate command and control to determine the missile's reaction to a given command. The missile's reaction will be either normal, sensitive, or sluggish.

(c) Bring the missile in a gentle arc over to the vertical centerline of the target (but not beyond) and approximately three target widths above the target. Stabilize the missile in this position.

(d) With about five seconds remaining of missile flight time to target, lower the missile slowly on the vertical centerline to the target horizontal centerline, being careful not to go below that line. Stabilize the missile on the center of mass and await impact.

d. The M55 sight can be used while firing from a static position or from any mode when the helicopter is equipped with yaw stabilization

(AN/ASW-12). The obvious advantage in using the M55 sight is the magnified view of the target and missile. Figure H-1 shows the M55 sight.

(1) The M55 sight reduces the problem of poor visibility because of range or natural causes. However, it cannot be successfully employed in any mode other than static without yaw stabilization. The narrow field of vision inherent in magnification sights results in the inability to keep the target and missile in sight.

(2) Use of the sight is restricted to targets beyond 1,000 meters. When the range to the target is less than 1,000 meters, the speed of the missile does not allow the gunner time to stabilize the missile, move the sight, and guide the missile to the target. The method of firing is as follows:

(a) The gunner estimates missile flight time to target.

(b) The pilot establishes the helicopter on a heading toward the target with the target centered in the MK8 sight. Engage the AN/ASW-12 heading lock by pressing forward and releasing the beep switch on the cyclic control. This locks the helicopter on the precise heading on which it was established.

(c) The gunner launches the missile and then initiates command and control to determine the missile's reaction to a given command. The missile's reaction will be either normal, sensitive, or sluggish.

(d) The gunner moves to the binoculars. Upon sighting the target horizontal centerline, stabilize the missile on the center of mass and await impact. Do not go below the target horizontal centerline.

(e) The pilot tracks a moving target with the flat rate turn control dial and the AN/ASW-12 beep switch. Keep the target centered in the MK8 sight.

e. The XM58 sight eliminates the disadvantages, and incorporates the advantages, of firing with the naked eye and firing using the M55 sight. Figure H-2 shows the XM58 gunner's sight. As long as evasive maneuvers are within 45 degrees of centerline azimuth and ± 15 degrees in elevation, the pilot may make evasive maneuvers without increasing the difficulties of the gunner using the XM58 sight. Because the gunner will have an unobstructed view with his left eye, he can observe the launch to impact without leaving the sight. In addition, the magnified monocular vision available to the right eye of the gunner will give the gunner a magnified view of the target at all times and at all ranges. The method of firing is as follows:

(1) The gunner estimates missile flight time to target.

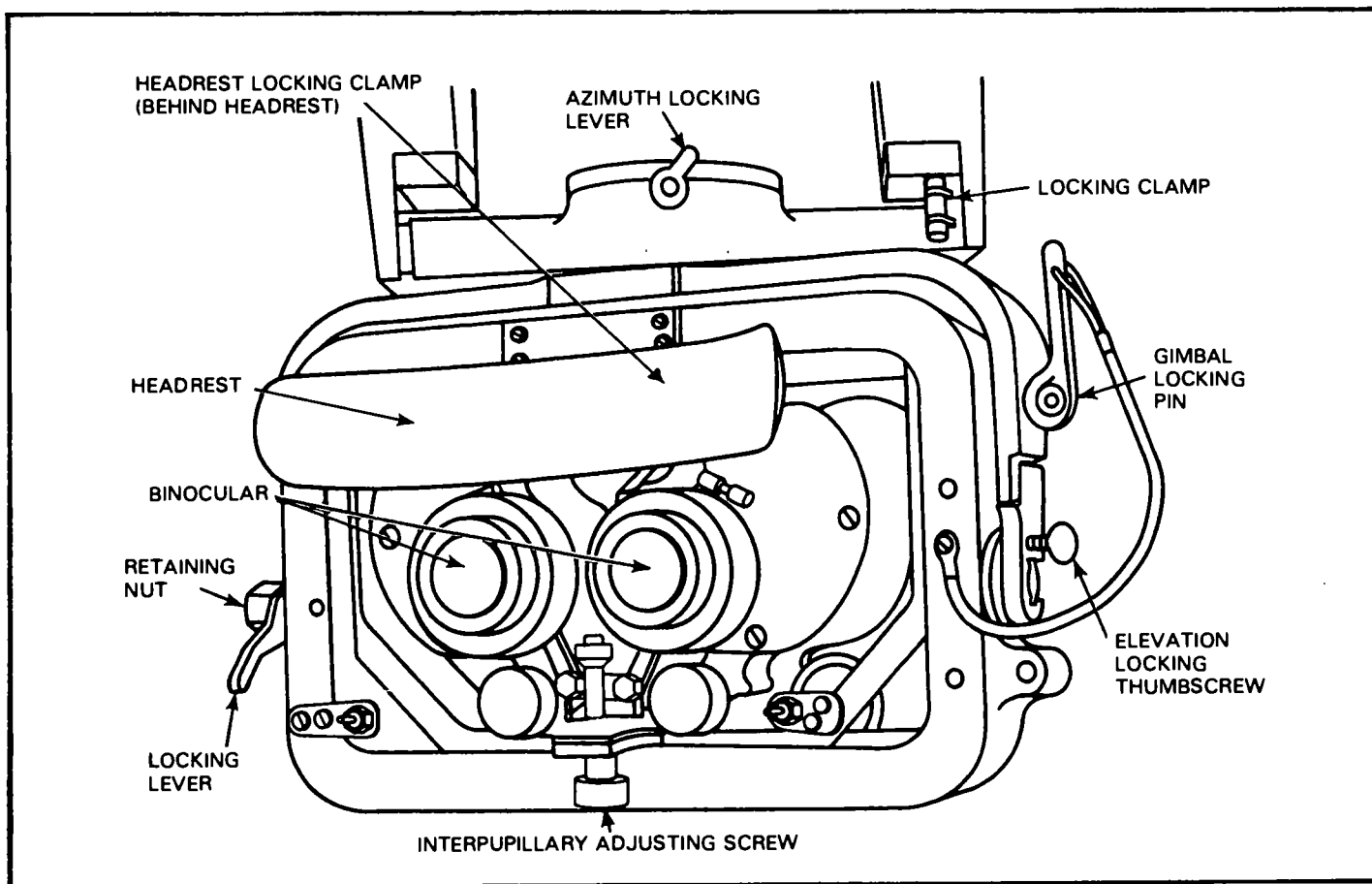


Figure H-1. M55 sight

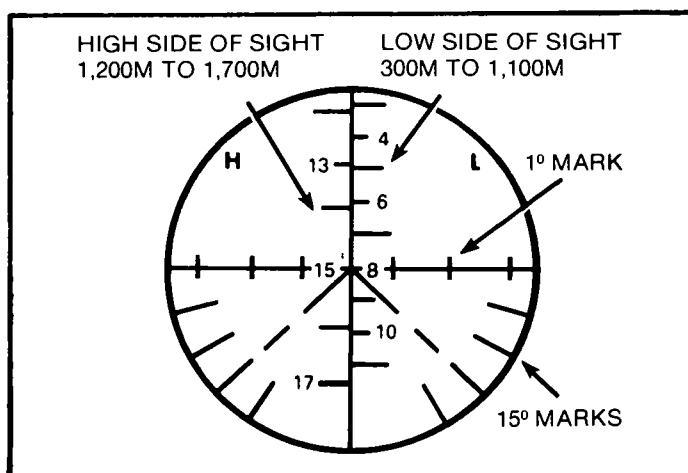


Figure H-2. XM58 gunner's sight

(2) The gunner establishes sight on target in azimuth and elevation with the gimbal position control or by hand until sight is stabilized in the proper position.

(3) The gunner brings the missile in a gentle arc over to the vertical centerline of the target (but not beyond) and approximately three target widths above the target. He stabilizes the missile in this position.

(4) The gunner stabilizes the missile on the center of mass and awaits impact.

(5) The pilot uses the line-of-sight indicator on the instrument panel to keep the helicopter within the 45-degree azimuth limitation. He uses the MK8 sight to keep within the 15-degree elevation limit.

(6) The gunner tracks a moving target with the gimbal position control.

H-2. M5 40-MILLIMETER RIFLED-BORE GRENADE LAUNCHER

a. H40-Millimeter Projectiles. The M5 helicopter armament subsystem can launch 40-millimeter antipersonnel fragmentation projectiles to provide a neutralization fire capability. Figure H-3 shows the M5 grenade launcher. The maximum rate of fire is 220 rounds per minute. The minimum burst is two rounds from the flexible or stow position. A single round can be fired from the subsystem by rapidly depressing and releasing the firing switch on either cyclic control stick. Maximum employable range is 1,750 meters, and maximum effective range is 1,500 meters. The minimum safe range for firing the M384 cartridge during training is 300 meters ; for combat firing, it is about 100 meters. Ammunition capacity for box

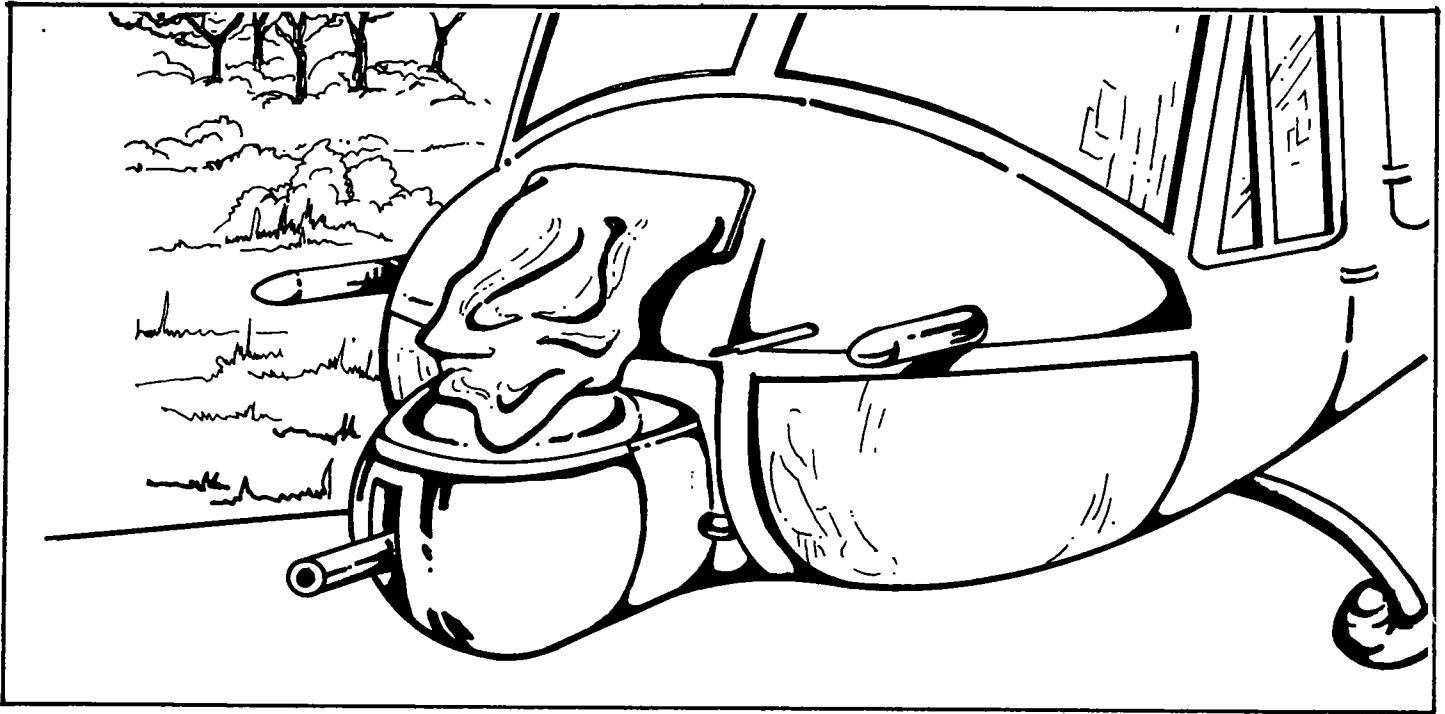


Figure H-3. M5 grenade launcher

fed is 150 rounds; for rotary-drum fed, it is 300 rounds.

b. 40-Millimeter Gun. The M5 subsystem employs a 40-millimeter gun, which is mounted in a flexible power-operated turret on the nose of the helicopter. The gunner aims and fires the gun using a hand control sight assembly. Within the physical travel limitations of the turret, gun control is independent of the helicopter's flight attitude. When the gunner releases the turret control switch, the turret returns to a fixed forward attitude (stow position).

(1) The pilot or the gunner can fire the gun in the stow position by depressing the firing switch

located on either cyclic stick. The pilot can preset or control gun elevation in the stow position by adjusting a wheel on the turret control panel assembly.

(a) **Azimuth limits.** The azimuth limits are 60 degrees right or left. Table H-2 shows target lead corrections.

(b) **Elevation limits.** The elevation limits are 15 degrees and -35 degrees. Table H-3 shows the correct angle of QE for 90 knots airspeed by slant range and altitude.

(2) The M5 subsystem is vulnerable to all types of air defense fires, including small arms. Operational effectiveness is reduced at night and

Table H-2. Target lead corrections

AIRCRAFT SPEED (KNOTS)	AZIMUTH TO TARGET (DEGREES)								
	- 60	- 45	- 30	- 15	0	+ 15	+ 30	+ 45	+ 60
0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
60	-6.3	-5.3	-3.7	-2.0	-0.4	+1.2	+2.9	+4.4	+5.5
90	-8.9	-7.3	-5.0	-2.6	-0.4	+1.9	+4.3	+6.6	+8.1

NOTE: Minus (-) indicates an azimuth or correction to the left. Positive (+) indicates an azimuth or correction to the right.

Table H-3. Slant range elevation adjustment

SLANT RANGE (METERS)	ABSOLUTE ALTITUDE		
	100 FT	500 FT	1,000 FT
	CORRECTION FACTOR		
	(MILS)	(MILS)	(MILS)
300	5		
400	19	-43	
500	33	-18	
600	47	4	-52
700	61	22	-25
800	75	43	-1
900	90	60	21
1,000	106	78	42
1,100	123	97	64
1,200	142	117	86
1,300	162	138	108
1,400	184	161	131
1,500	208	185	156
1,600	235	211	182
1,700	264	240	210
1,800		272	240
1,900			273

during periods of low visibility because of target acquisition and range estimation limitations. Engagement of targets is limited by the subsystem's flexible limits in relation to gun-target range and helicopter altitude, airspeed, and degree of bank.

H-3. M21 ARMAMENT SUBSYSTEM

a. The M21 subsystem provides the commander with an immediately responsive and highly mobile means for armed reconnaissance and continuous direct and indirect fires. Figure H-4 shows the M21 subsystem. The subsystem can deliver offensive or defensive area fires by means of rockets or automatic guns against personnel in the open, soft materiel targets, and lightly armored vehicles. Its dual-weapon capability permits selection of the best weapon for the target or simultaneous engagement of two area targets.

b. The subsystem has two high-rate-of-fire, 7.62-millimeter M134 automatic guns. The automatic guns are combined with two M158A1, 2.75-inch rocket launchers.

(1) Each 7.62-millimeter automatic gun is in an electrically driven, air-cooled, six-barrel weapon

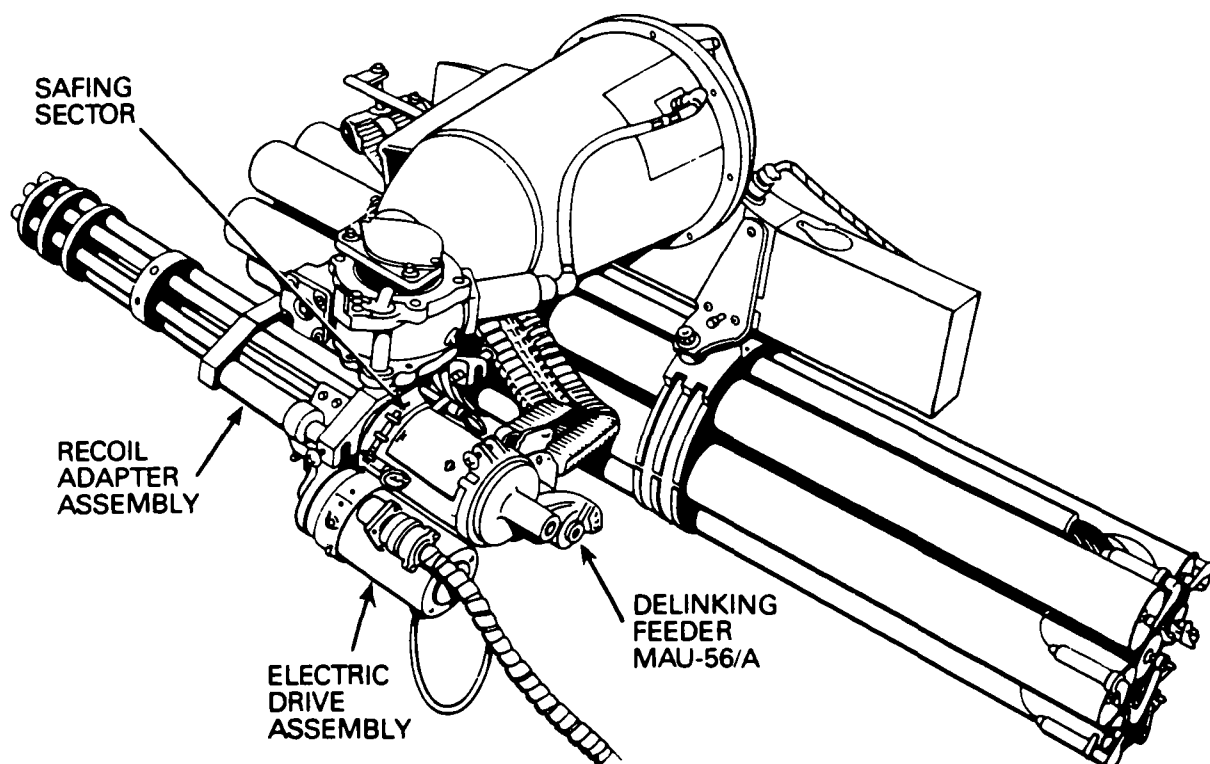


Figure H-4. M21 armament subsystem

that fires 2,000 to 4,000 shots per minute. The automatic gun portion of the subsystem is operational in the stow or flexible mode. Three seconds after depression of the firing switch on the cyclic stick or flexible sighting station, a burst limiter will stop the firing. Each gun ceases firing and clears itself by continuing to drive without being fed ammunition. A minimum of six live rounds will be cleared through each feeder and ejected overboard. Releasing the firing switch during a burst or activating the limit switches will cause the guns to clear.

(a) The gunner can fire the 7.62-millimeter subsystem automatic guns from the stow or flexible position. The pilot-gunner can fire the subsystem only from the stow position. The CPG uses the flexible automatic gun sighting station to aim and fire the guns in the flexible mode. The sighting station controls allow the gunner to remotely position the guns within the flexible limits of ± 10 degrees of elevation to -90 degrees of depression and from 12 degrees inboard traverse to 70 degrees outboard. When not in use, the sighting station may be stowed over the gunner's head.

(b) The pilot can use the XM60 infinity sight for stow fire by turning the ELEVATION/DEPRESSION knob until the sight rounds. Figure H-5 shows the XM60 in infinity sight. When using the sight to observe the strike of tracers fired from fixed guns, the pilot changes the attitude of the helicopter to aim the guns. Therefore, accuracy of fire delivery is limited by helicopter maneuverability.

(2) Each M158A1 rocket launcher has seven tubes that fire 2.75-inch FFARs. The launchers are reusable, and the launcher tubes are replaceable individually. A rocket selector switch allows the selection of one to seven pairs of rockets. The pilot uses the XM60/XM60E1 infinity sight to aim the rockets by placing the sight pippin on the target. Table H-4 shows the range and elevation of the infinity sight. When using the sight to place the

pippin on the target or by firing in an indirect mode, the pilot changes the attitude of the helicopter to aim the guns. Therefore, accuracy of fire delivery is limited by helicopter maneuverability.

c. The subsystem will function in all coordinated helicopter positions or attitudes and within helicopter speeds of 0 to 20 knots. It can be operated in all tactical environmental conditions in which the helicopter can operate. The rocket launchers can be electrically or manually jettisoned in case of an in-flight emergency. The automatic guns and rocket launchers can easily be replaced if rendered inoperative by combat damage. The subsystem is capable of selective fire in the following modes:

- High-rate, 7.62-millimeter automatic guns.
- Flexible, using gunner's flexible sighting station.
- Stowed, using the XM60 infinity sight and the firing switch on the cyclic control stick.
- 2.75-inch FFAR.
- Pair—single rocket from each launcher.
- Ripples of 2, 3, 4, 5, 6, or 7 pairs (14 rockets).

d. The M21 is highly accurate when both guns are boresighted or harmonized to converge at 1,000 meters and when the rocket launchers are boresighted to converge rocket fires at 1,250 meters. Its maximum employable range is 3,200 meters for 7.62-millimeter automatic guns and 9,300 meters for 2.75-inch FFARs. Its maximum effective range is 1,500 meters for 7.62-millimeter guns and 3,000 meters for 2.75-inch FFARs.

e. The subsystem has some limitations. It is vulnerable to all types of air defense fires, including small arms. Operational effectiveness is reduced at night and during periods of low visibility because of target acquisition and range estimation limitations. Engagement of targets is limited by the subsystem's gun or launcher limits in relation to gun-target range and helicopter altitude, airspeed, and degree of bank.

Table H-4. XM60/XM60E1 Infinity sight

<u>RANGE (METERS)</u>	<u>ELEVATION (MILS)</u>	<u>RANGE (METERS)</u>	<u>ELEVATION (MILS)</u>
1,000	+64	3,500	-24
1,500	+53	4,000	-54
2,000	+40	4,500	-91
2,500	+23	5,000	-136
3,000	+2	5,500	-196

NOTE: This table is for hover fire only, 10-pound warheads. For 17-pound warheads, add -20 mils to all settings.

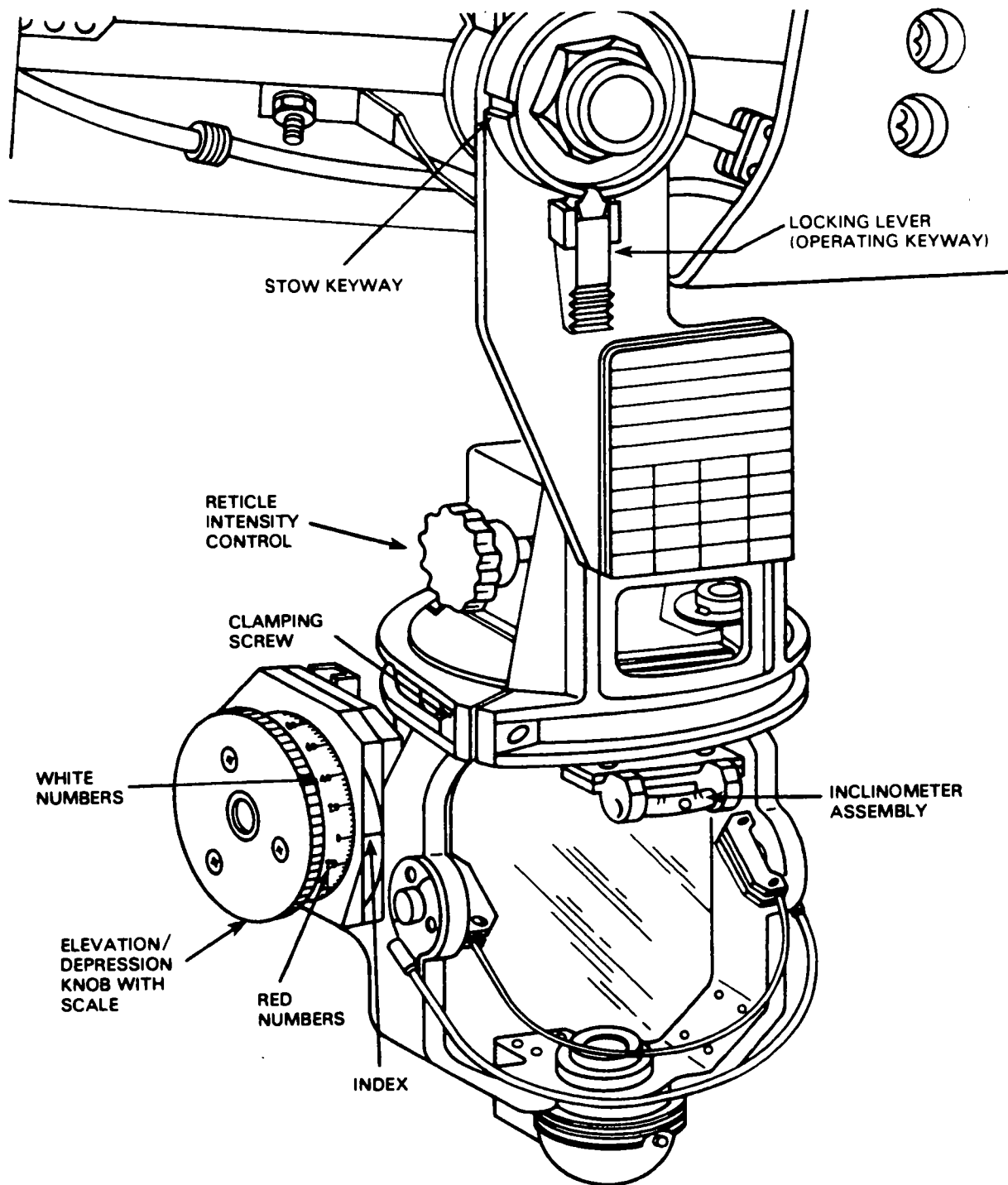


Figure H-5. XM60 infinity sight

FIRING WEAPON SYSTEMS OF THE AH-64

The AH-64 Apache helicopter gives the Army an antiarmor capability for day, night, and adverse weather operations. Weapon firepower, range and accuracy, and target acquisition and tracking have improved significantly from previous models. The AH-64 also has built-in crash and ballistic protection for increased survivability.

Section I SYSTEMS

I-1. FIRE CONTROL COMPUTER

The fire control computer is the primary bus controller. It controls all data transmissions during normal operations, processes and computes fire control information for all weapon systems, and computes line-of-sight information for target acquisition and tracking. In addition, the FCC monitors itself and all subsystems that it controls. It provides fault status of critical systems to the flight crew through the fault detection and location system. Crew members input to the FCC through the data entry keyboard for manual range, laser codes, FD/LS interrogation, target/navigation location, and special information.

I-2. SYMBOL GENERATOR

The FCC directs symbology displayed by the symbol generator on any of the available displays as requested by the crew members. Symbology covers aircraft flight control, weapon employment, and weapon and sight status. Symbology consists of graphic information and planned tests. With symbology, the crew member can operate the aircraft during normal and instrument meteorological condition operations without reference to other cockpit instruments. Symbology is generally divided into four groups: flight symbology, weapon symbology, high action display, and alphanumeric display.

a. Flight symbology, used primarily by the pilot, provides information for precision aircraft control, in flight and at a hover, without outside reference. Four modes can be selected by the pilot: hover, transition, cruise, and bob-up. The modes reduce symbology clutter since the pilot receives only the information for the mode selected. Required weapon symbology is displayed when the pilot selects a specific weapon system.

b. Weapon symbology is used primarily by the CPG. It provides information for weapon and sensor control and monitoring of the FD/LS system. Additional symbology is provided when the CPG selects a weapon system for his use.

c. The high action display (Figure I-1) is located in the lower right and left portion of the selected display. It provides both the pilot and CPG with plain text information concerning weapon and sight status, weapon control, and range information.

I-3. AIR DATA SENSOR SUBSYSTEM

The ADSS consists of an omnidirectional airspeed sensor and an air data processor. The ADSS senses airspeed, temperature, and pressure. It provides this information via the MUX BUS to the appropriate systems for controlling aircraft stabilization, navigation, and fire control.

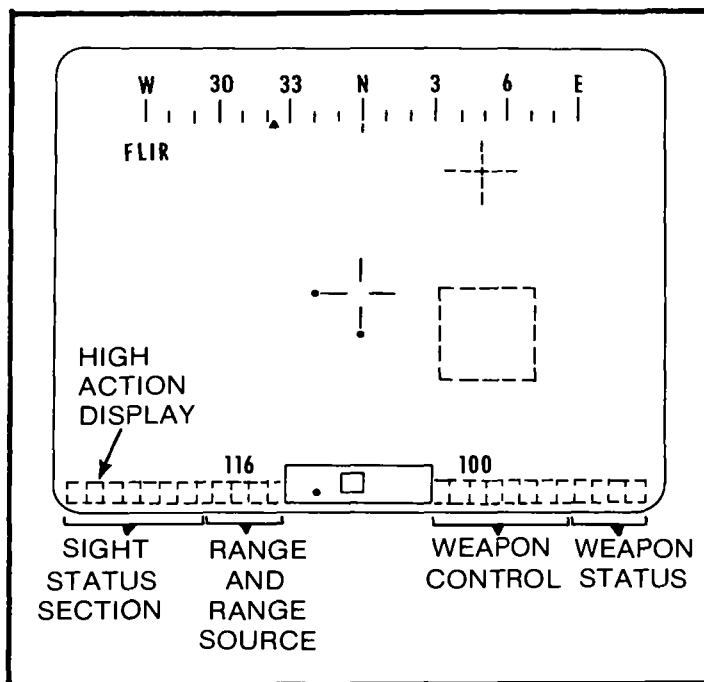


Figure I-1. High action display

I-4. INTEGRATED HELMET AND DISPLAY SIGHT SYSTEM

The IHADSS consists of crew member helmets, a helmet display unit, sight survey units, a display adjust panel, a boresight reticle unit, and sight and display electronics units. Using phased and timed

infrared light beams from the SSUs which are sensed by detectors on the crew member's helmet, the SEU determines the accurate LOS of each crew member. Weapons and sensors can then be slaved to the LOS. Infrared light use reduces helmet weight and interference previously experienced with mechanical linkages. The HDU is mounted to the right side of the crew member's helmet and consists of a CRT with optical lenses that project selected symbology and imagery on a combiner lens in front of the crew member's right eye. Because the HDU is mounted to the helmet, information is available to the crew member regardless of head position.

I-5. PILOT'S NIGHT VISION SENSOR

The PNVS (Figure I-2) is a stabilized, infrared imaging system mounted on the nose of the aircraft in a rotating turret. When selected, it is slaved to the crew member's LOS and displayed through the IHADSS HDU along with appropriate flight symbology. With the PNVS, the crew member's vision is aided for NOE flight at night or during adverse weather. Since the PNVS uses infrared energy to produce its imagery, its use is not dependent on any available light source. PNVS controls are on the pilot's fire control panel.

I-6. TARGET ACQUISITION AND DESIGNATION SYSTEM

The TADS provides the CPG with day and night target acquisition by means of a DVO telescope, a

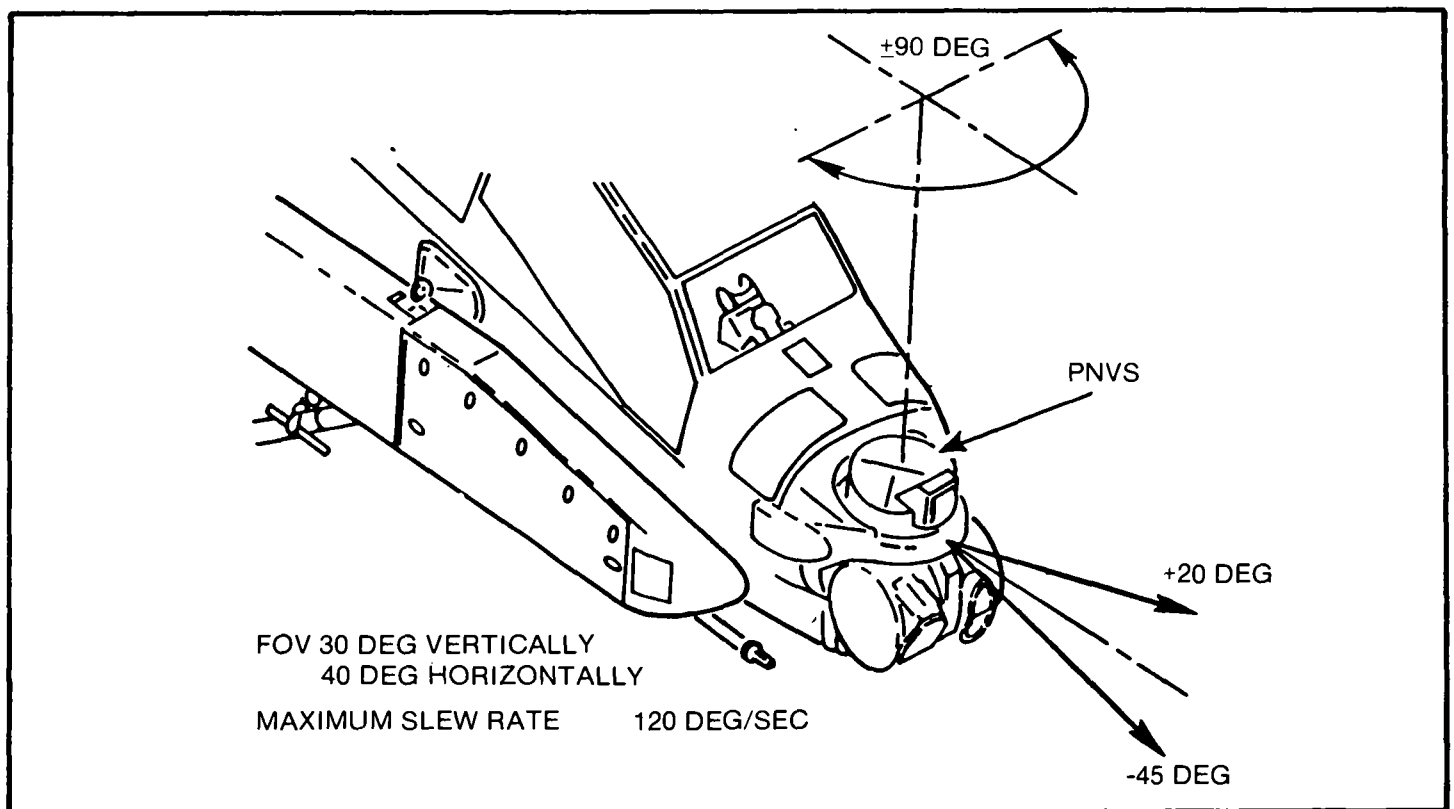


Figure I-2. Pilot's night vision sensor

DTV, and an infrared imaging sensor system (FLIR) mounted in a rotating turret below the nose of the aircraft. Each sensor has multiple fields of view. Imagery is provided to the CPG by the ORT and may be viewed either heads-out or heads-down. Control of the TADS functions is provided for on the ORT. Target tracking may be accomplished automatically with the IAT or manually. Linear motion compensation provides motion compensation and rate-aiding for tracking moving targets. The LRF/D provides coded laser energy for point target weapon system guidance and range information. The TADS may be cued to a target by the pilot's LOS, CPG's LOS, or Hellfire missile seeker LOS or by the FCC based on a known target location input through the DEK. The LST can cue the TADS to a target by tracking the laser energy from another laser designator, facilitating rapid target handovers. TADS functions also include storing target coordinates and updating present position without overflying the target or checkpoint. In addition, wide field of view FLIR may be commanded by the pilot as a backup should his PNVS fail.

a. TADS Component Locations. The TADS turret is mounted on the nose of the helicopter at fuselage station 35.5. Component locations are illustrated in Figure I-3. The TADS turret limits are

depicted in Figure I-4. Attached to the face of the turret is the ORT, which projects into the CPG crew station. The TEU LRU, the LEU LRU, and the TADS power supply LRU are located in the left-hand forward avionics bays.

b. TADS FLIR Capabilities. The TADS FLIR capabilities are illustrated in Figure I-5. The same scene is depicted using different fields of view. The TADS FLIR has four fields of view. The wide, medium, and narrow FOV are true optical fields of view that are obtained by using mirrors and lenses. The zoom FOV, however, is actually a 50-percent electronic underscan of the narrow FOV video. When the NFOV is underscanned, some resolution is lost. FOV corners indicate the area that will be displayed in the next narrower FOV.

c. TADS DTV Capabilities. The TADS DTV capabilities are depicted in Figure I-6. The same scene is depicted using different fields of view. The TADS DTV has three fields of view. The wide and narrow FOV are true optical fields of view that are obtained by using lenses and prisms. The ZFOV, however, is actually a 50-percent underscan of the NFOV video. When the ZFOV is underscanned, some resolution is lost. FOV corners indicate the area that will be displayed in the next narrower FOV.

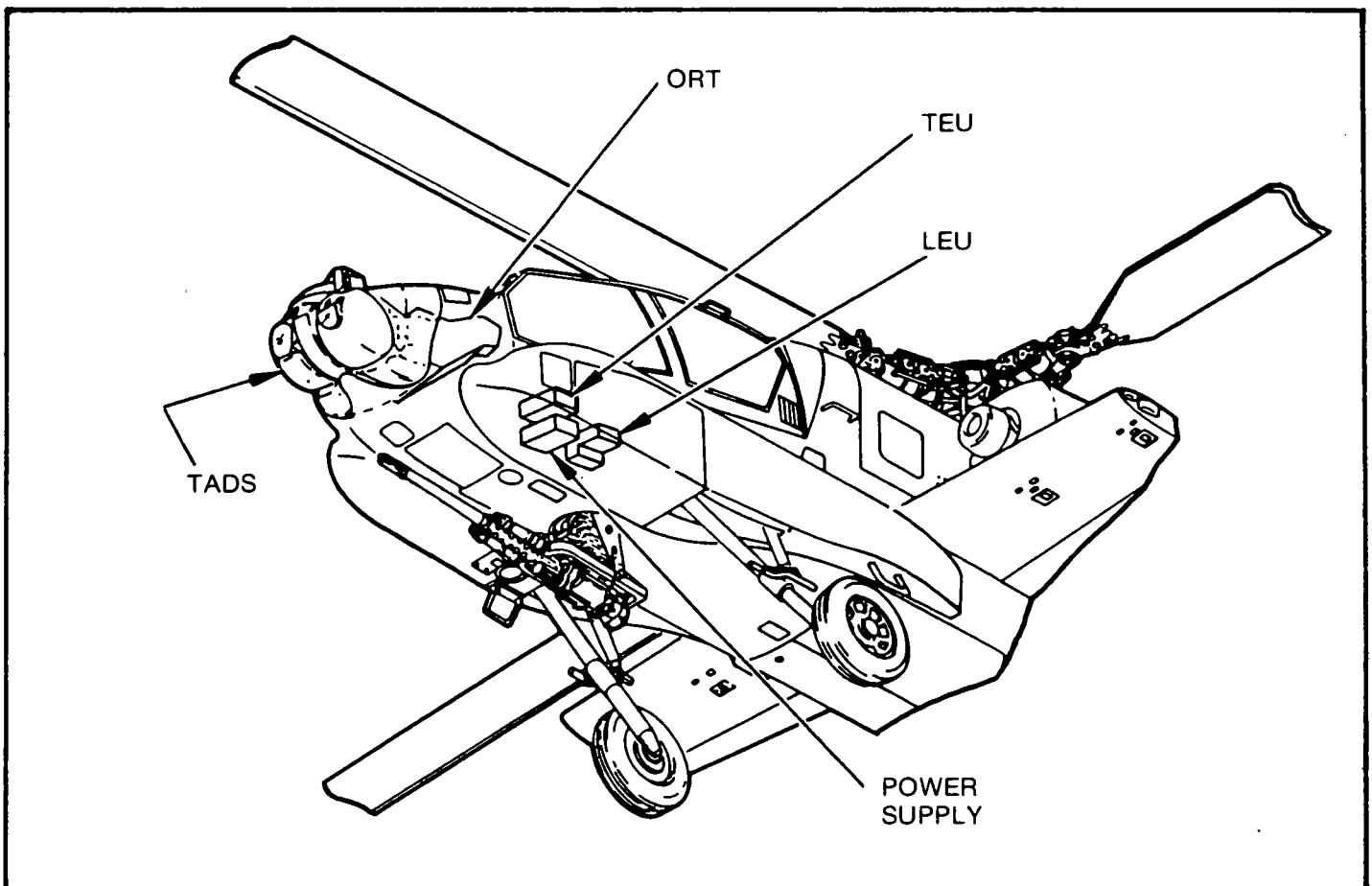


Figure I-3. TADS component locations

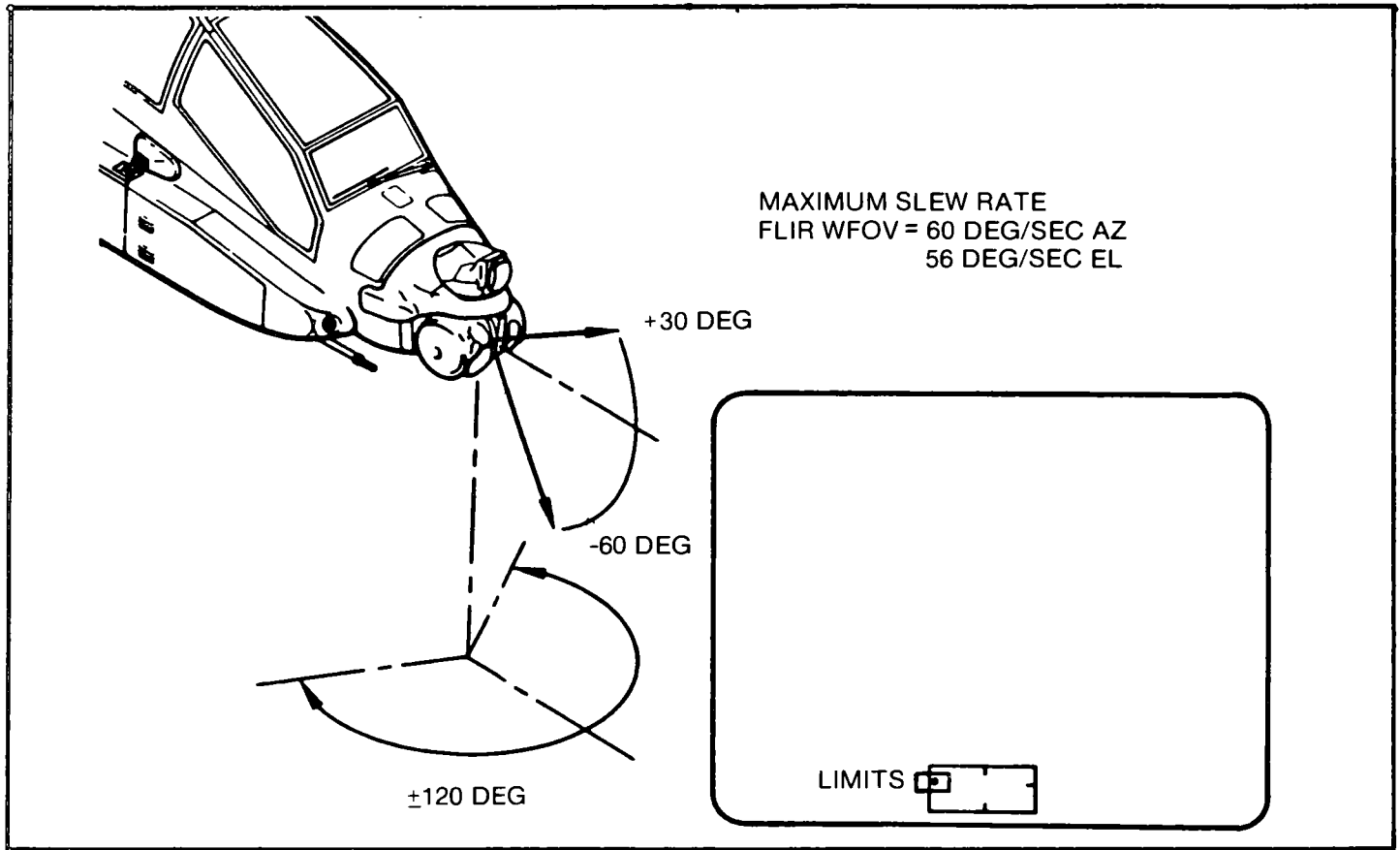


Figure I-4. TADS turret limits

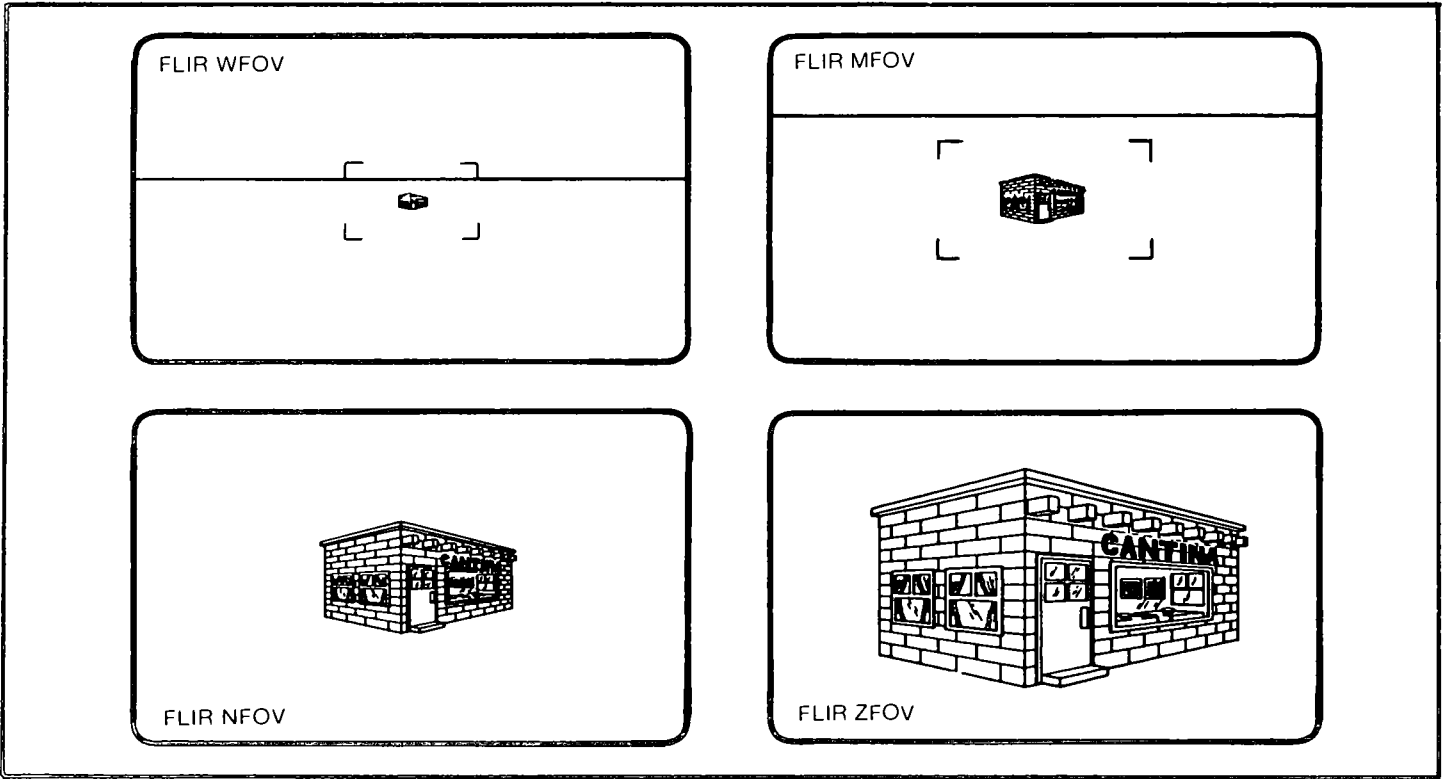


Figure I-5. TADS FLIR capabilities

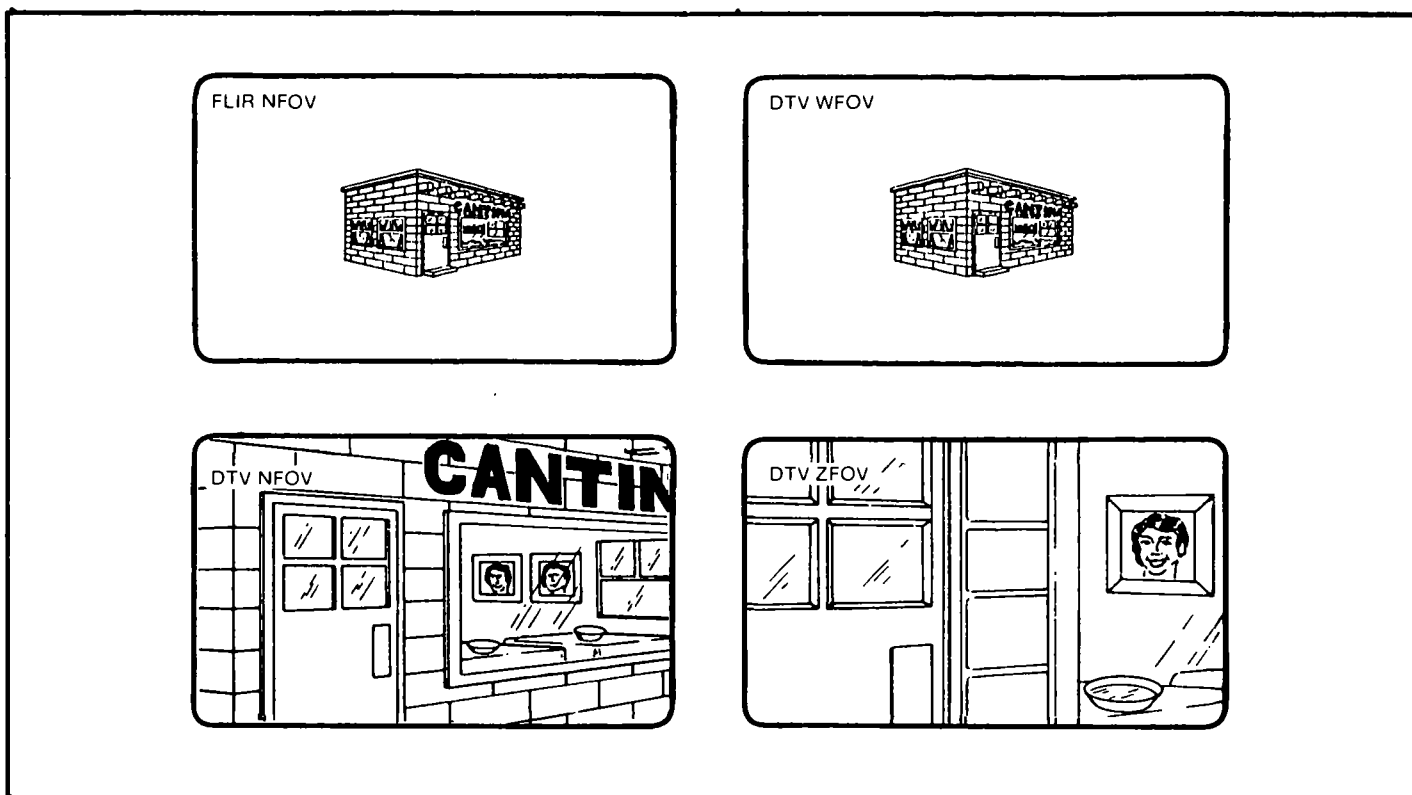


Figure I-6. TADS DTV capabilities

d. Direct View Optics Capabilities. Direct view optics are depicted in Figure I-7. The CPG selects the DVO by placing the sensor select switch

in the DVO position. When DVO are selected, the trip mirror will rotate clockwise out of the DVO path so the DVO can be presented to the CPG.

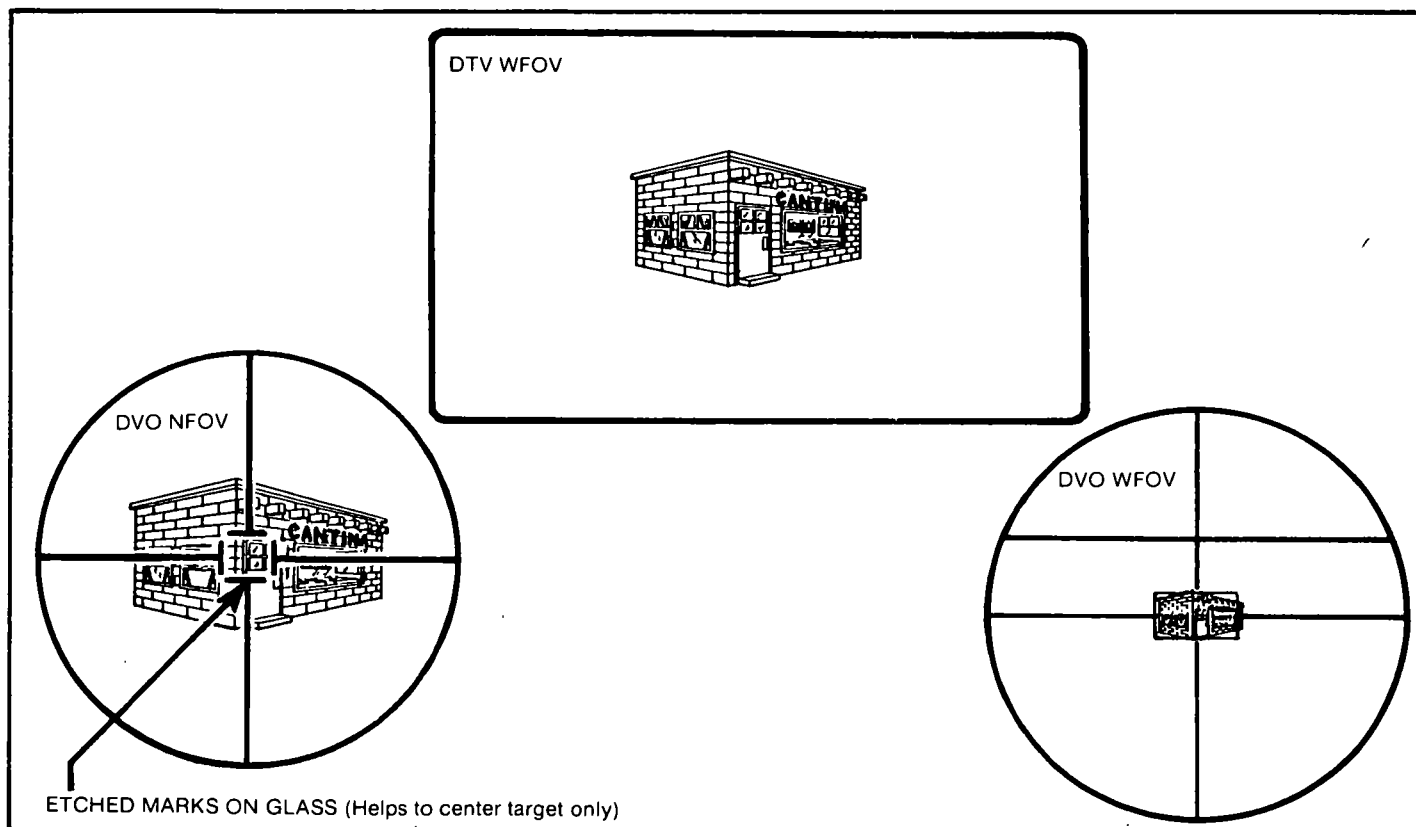


Figure I-7. Direct view optics

While DVO are selected, the DTV presentation (in the same FOV as selected for DVO) is available for display on the HOD and the IHADSS HDU. The message "DVO" will be shown in the upper left portion of the video (DTV) display to indicate the DVO have been selected. When either DTV or FLIR is selected, the trip mirror will rotate counter-clockwise, interrupting the DVO path and clearing the HDD path. Either at the bottom or below the selected presentation is a display of alphanumeric messages appearing on the alphanumeric display. All optical paths are eye-safe to laser energy. The DVO have two fields of view: wide (W), 18.0 degrees; and narrow (N), 4.0 degrees.

I-7. LASER SPOT TRACKER

The LST detects, decodes, and tracks reflected laser energy. It does not share an optical path with any other sensor. The LST consists of an optical assembly, a detector, and a signal processor.

a. Laser Spot Tracking. To engage laser spot tracking, the SIGHT SEL switch must be in the TADS or HMD TADS position. The TADS is not slaved to the IHADSS LOS or to an ACQ SEL switch function, and the TADS IAT is not selected.

b. LST Operational Search Modes. The LST has two operational search modes. These modes are manual and automatic.

(1) Manual. When the CPG positions the laser spot tracker switch in the MAN position, the TADS will respond to MAN TKR controller inputs. The message "LST SEARCH" will be displayed in the tracker status section of the AND. The message indicating the assigned laser code of the LST will be displayed in the AND LST and LRF/D code status section of the AND; for example, "CODE; LST = A."

(2) Automatic. If the switch is placed in the AUTO position, the MAN TKR controller will be disengaged and the signal processor will drive the TADS in a four-box search pattern centered about the point of engagement. The message "LST AUTO SEARCH" and the LST code will be displayed in the AND.

c. LST Failure. If the LST fails when selected, the message "LST FAILED" will be displayed in the tracker status section of the AND. The LST portion of the LST and LRF/D code status section of the AND will blank.

d. Laser Energy. When the LST detects laser energy of the proper code, the signal processor will command the TADS LOS to the center of the detected laser energy. The autosearch pattern of MAN TKR controller will be disengaged. The message "LST TRACKING" and the LST code will be displayed in the AND.

e. LST Operational Code. To select the operational code for the LST, the CPG uses the LST indexer on the FCP. The CPG sets it to the index (A through H) representative of the code storage location within the bus controller.

I-8. LASER RANGE FINDER/DESIGNATOR

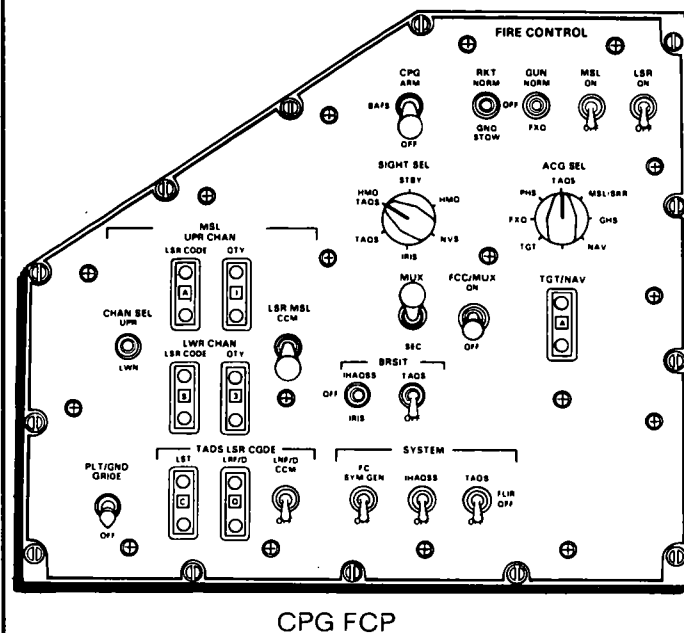
a. Purpose. The LRF/D (Figure I-8) provides coded, pulsed laser energy for designating targets and provides range-to-target data for the fire control system. The LTU generates, on command, the laser energy of a specific code. This energy is reflected by the laser prism and sent out through the NFOV lens for target designation. Reflected laser energy is routed back through the NFOV lens. It reflects upward into the LTU by the laser prism and generates range-to-target data.

b. Operations. The LRF/D can be used with any sensor and the IAT. To select the operational code for the LRF/D, the CPG uses the LRF/D thumb wheel on the FCP. The CPG sets it to the index (A through H) representative of the code storage location within the bus controller. The laser requires arming actions, similar to a weapon, before it can be fired. To aim the LRF/D, the CPG places the TADS switch to the FLIR OFF or TADS position and ensures the LRF/D CB is in. The CPG positions the sight select switch to TADS or HMD/TADS, aims the FCP, and sets the laser switch to the ON position. If the helicopter is on the ground, the CPG will set the PLT/GND ORIDE to ORIDE. The FCP is now armed. As the last action required, the CPG then pulls the laser trigger. The LRF/D shares the same optical path as the DVO NFOV and the DTV.

(1) Ranging an object. To range an object, the laser trigger is pulled to the first detent. The laser fires three pulses in one second and then stops firing. Calculated range is now displayed. The range will increase or decrease for seven seconds after the laser stops firing at the rate the helicopter was moving when the range was calculated.

(2) Designating a target. To designate a target, the laser trigger is pulled and held in the second detent. The LRF/D will then continuously fire the laser on the code selected by the LRF/D laser code indexer until the trigger is released. When the laser is being fired using the second detent position of the laser trigger, continuous range update is displayed in the range section of the high action display. The range is expressed in meters; 10 kilometers is the maximum displayed laser range.

(3) Counter-countermeasuring. There is a counter-countermeasures switch (LRF/D CCM) on the CPG's FCP. This switch activates the countermeasures functions of the LRF/D.



LRF/D ... TEMP
 LRF/D ... COOLANT
 IMPEND ... LASER ... INHIBIT
 LASER ... INHIBIT
 LRF/D ... ENERGYLO
 RFD = A

AND messages

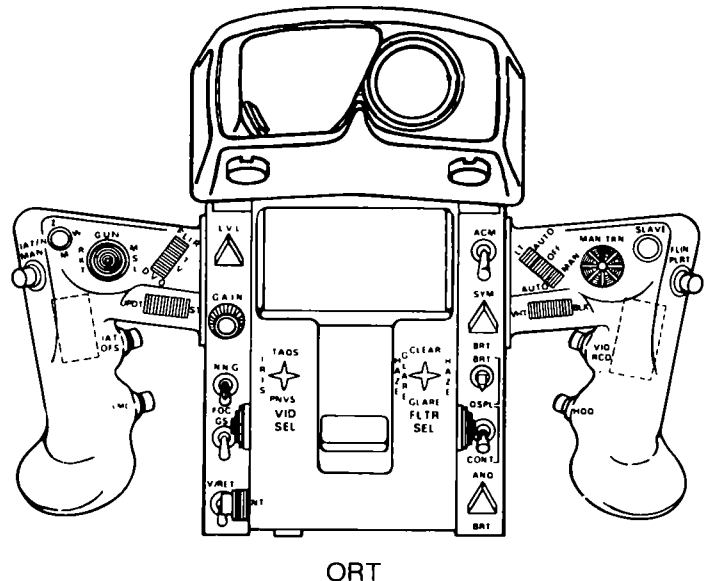


Figure I-8. Laser range finder/designator

(4) **Displaying status messages.** Status messages pertaining to the LRF/D may be displayed in the sight status section of the AND. These messages are shown in Figure I-8 and explained in Table I-1.

(5) **Displaying the code selected.** The code selected for the LRF/D will be displayed to the right of the LST code in the LST and LRF/D code status section of the AND. The message will blank if the LRF/D has failed. These are examples of codes: LST = A and RFD = A.

gun may be fired in either a flex or fixed mode by either the pilot or CPG using IHADSS LOS or by the CPG using TADS LOS. The AWS interfaces with the FCC through the MUX BUS. It receives ballistic corrections from the FCC when operated in the flex mode. The 30-millimeter gun fires an HE shaped-charge projectile and is compatible with NATO ammunition.

a. AWS Weight. The complete system has an estimated empty weight of 199.8 pounds. With a full complement of approximately 1,110 rounds, it weighs 1,054 pounds. An additional 90 rounds can be loaded in the chute for a system total of 1,200 rounds.

b. Duty Cycle. The gun duty cycle is as follows: six 50-round bursts with five seconds between bursts, followed by a 10-minute cooling period. For burst limiter settings other than 50, the duty cycle can be generalized as no more than 300 rounds fired within 60 seconds before allowing the gun to cool for 10 minutes. The cycle may then be repeated.

I-9. AREA WEAPON SYSTEM

The AWS (Figure I-9) consists of a 30-millimeter, single-barrel cannon mounted in a flexible turret on the underside of the aircraft and an ammunition handling system located in the fuselage below the wings. Both the turret and ammunition handling system are hydraulically powered while the 30-millimeter gun is electrically driven. The

Table I-1. AND status messages and indications

STATUS MESSAGE

LRFD . . . TEMP

LRFD . . . COOLANT

IMPEND . . . LASER . . . INHIBIT

LASER . . . INHIBIT

LRFD . . . ENERGY LO

INDICATION

The LRF/D has overheated.

The LRF/D coolant level is low.

The laser is about to be inhibited because it is approaching either a performance or safety limitation.

The laser is being inhibited because it is at a safety or performance limit. (Pulling the laser trigger to the second detent will override performance inhibitors and operate the laser.)

The level of the laser output energy has dropped below a preset level, thus reducing the effectiveness of the LRF/D.

c. Burst Limit. Changing the burst limit to fire each time the trigger is pressed must be done on preflight by the crew. The burst can be set to 10, 20, 50, 100, or ALL rounds.

d. Turret Slew Limits. The turret can move from +11 degrees in elevation to -60 degrees in depression and 110 degrees left or right of center in response to the TCB. Mechanical stops limit turret

motion to +11 degrees in elevation, within 1 degree beyond azimuth position limits, and within 3 degrees beyond depression position limits. In case of power failure, hydraulic or electrical, the turret will return to the safe stow position but will remain in the last azimuth position. Whenever an action signal is removed, the turret will return to a safe stow position at the elevated mechanical stop and at a 9-degree azimuth.

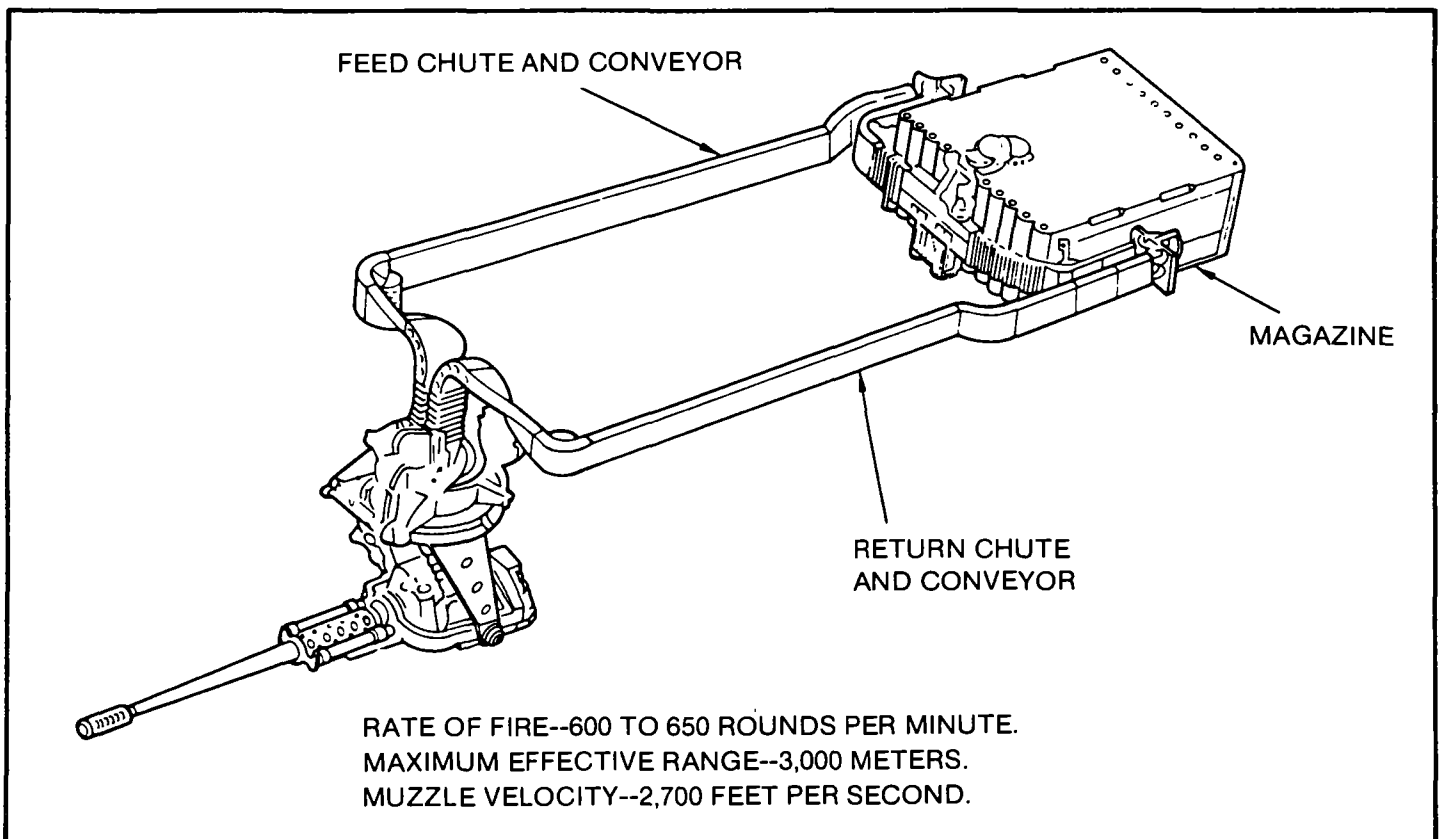


Figure I-9. Area weapon system

e. Turret Control Box. The TCB monitors pilot and CPG action signals. Should the TCB receive action signals from both crew members, it will assign priority to one based on the last WAS position. The TCB will notify the FCC/BBC which crew member is in control.

(1) Inhibit signals (TCB generated). A gunfire inhibit signal is sent to the FCC whenever an out-of-coincidence condition exists or the burst limit is reached. In an out-of-coincidence condition, the TCB will compare the actual turret position with the commanded position for azimuth and elevation. If the difference, which is corrected for known standoff errors in a dynamic condition, exceeds 0.5 degree, the TCB will inhibit gunfire.

(2) Inhibit signals (FCC/BBC generated). A gunfire inhibit signal is sent to the TCB by the FCC/BBC for either of two conditions. First, if the squat switch is in the GROUND position and the gun is being driven toward a position lower than -1.7 degrees, then the FCC/BBC will prevent the gun from being driven lower than -1.7 degrees. Second, if the turret touches any slew limit, the gun will also stop firing.

I-10. AERIAL ROCKET CONTROL SYSTEM

The ARCS consists of a rocket control panel mounted in the pilot's station and a station director in each wing store pylon. With the ARCS, the aircrew can load and selectively fire up to five different zones of the 2.75-inch FFAR warhead/ fuze/motor variation when using four M261 launchers or three zones with two M261 launchers. The thumb wheel switches at the top of the rocket control panel are set by the rocket-loading crew. They are confirmed by the aircrew to designate the type of rockets loaded into the rocket launcher

zones. This provides information to the pilot on weapon loading and to the FCC for fire control solutions. The fuze type, quantity, and target range can also be set by the pilot. Rockets may be fired by either the pilot or CPG using IHADSS or in a cooperative mode using TADS LOS.

a. ARCS Functions. The ARCS—

- Manually controls the fuze range setting for tree height.
- Provides data to the fire control computer for the time-of-function calculation for the fuze setting.
- Controls the launching rate time interval between singles, pairs, or quads.
- Controls the quantity of rockets launched in each volley.
- Controls the zones from which rockets are launched.
- Displays the quantities of remaining rockets in each zone.
- Controls the range input to the FCC for all weapons.

b. ARCS Selection Capability. The system can select up to five warhead or fuze rockets from any of five firing zones. Each ZONE SEL switch on the rocket control panel unit is a push-button switch with either a select or deselect discrete function. There are five distinct zones (Figure I-10). The zones are as follows:

- Zone A—outboard outer ring, 24 tubes (12 per launcher).

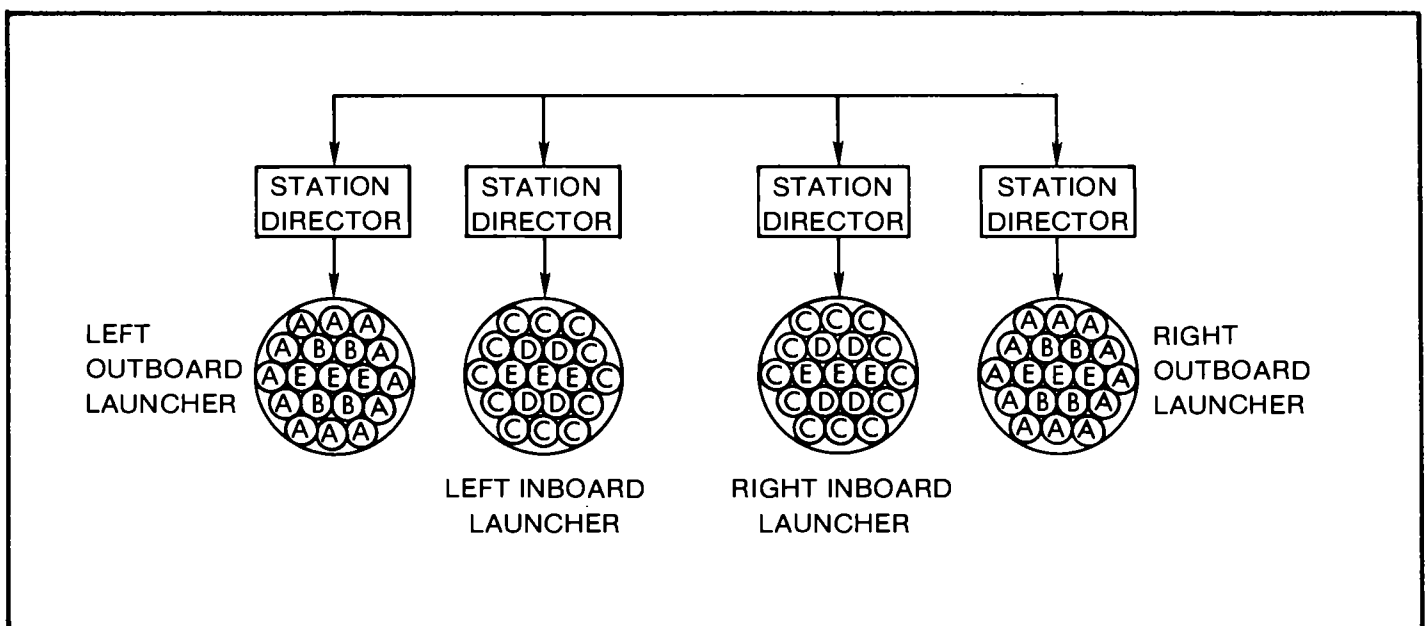


Figure I-10. Five firing zones of the ARCS

- Zone B—outboard inner four, 8 tubes (4 per launcher).
- Zone C—inboard outer ring, 24 tubes (12 per launcher).
- Zone D—inboard inner four, 8 tubes (4 per launcher).
- Zone E—outboard and inboard inner three, 12 tubes (3 per launcher).

c. Rocket Control Panel Unit. The control and display panel is organized in four sections of indicators, displays, and switches. These are described below.

(1) Warhead/fuze indicators. The top row of the RCPU provides warhead/fuze data to the pilot for reference and to the FCC for fuze requirements and ballistic information. The switches rotate in either direction and may represent 11 different identification codes loaded into each of the five zones.

NOTE: The crew monitors these indicators which should be initially set and updated as appropriate.

(2) Zone selection switch (ZONE SEL). Zone selection is made by pressing the appropriate panel. Selection of a zone will automatically select all zones loaded with the same type of warhead/fuze.

NOTE: Do not load dissimilar warhead/fuze types into the same zone. Zone selection is indicated by the illumination of the ZONE SEL switch. Selecting a new zone automatically cancels any previous selections.

(3) Rounds remaining indicator (RND REM). This row on the RCPU provides the pilot with a visual reference of the number of rockets remaining in each of the five zones. The indicator consists of a five-section, digital display readout. After each firing, the quantity of rockets within each zone is established and updated automatically when the aircraft 28 VDC power is applied via the MUX. Momentary power interruptions will not cause erroneous displays.

(4) Quantity selection switch (QTY). With this switch, the pilot can select the quantity of rockets to be fired. It is a rotary thumb wheel with seven discrete positions. The quantity of rockets that the pilot selects from a zone or zones may be 1, 2, 4, 8, 12, 24, or ALL.

(5) Penetration selection switch (PEN-M). With this switch, the pilot can select the desired penetration depth of resistor capacitor fuze (M433).

warheads. It is a rotary thumb wheel with 10 discrete positions. The height of tree canopy penetration can be selected from 5 to 45 meters in 5-meter increments. The selected figure is then sent to the FCC. The ARCS will accept fuze-setting data from the FCC and will charge the fuze accordingly. The ARCS also permits selection of superquick or bunker penetration and will charge the fuze accordingly.

(6) Range selection switch (RNG-KM). With this switch, the pilot can select manual or automatic range settings. The switch has dual thumb wheels with 10 discrete positions on each wheel. The manual settings range from 100 to 9,900 meters. Automatic ranging may be chosen by selecting an "A" on the left thumb wheel or by selecting "0.0" on the left thumb wheel. The laser range finder will then provide range input to the FCC.

d. Safety Inhibitors. FCC-generated safety inhibitors prevent rockets from firing when any of the following conditions exist:

- When the gun is out of coincidence.
- When the aircraft's vertical acceleration is +0.5G or less.
- When the pylon servos are out of coincidence with the FCC-commanded position by greater than 3.5 degrees.

e. Rocket Interval. The ARCS automatically controls the interval of rocket firing at 60 milliseconds.

f. Rocket Steering Cursor. This cursor (Figure I-11) indicates to crew members the alignment criteria for a correct rocket fire control solution below 100 knots. The cursor may be located at any "X" or "Y" position within the display limits. It is a solid vertical line terminated on each end by an orthogonal dashed line.

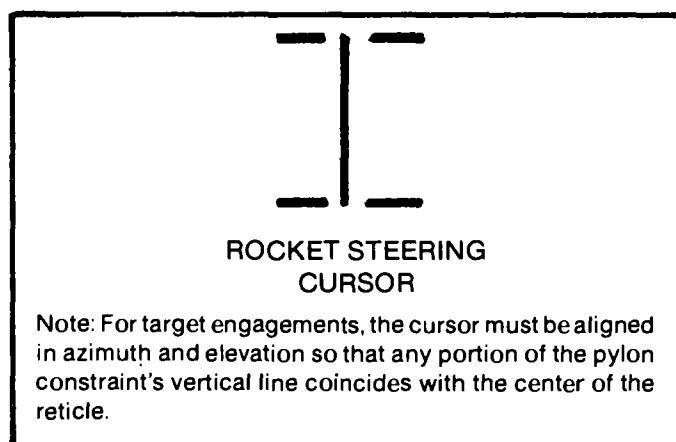


Figure I-11. Rocket steering cursor for below 100 knots

I-11. POINT TARGET WEAPON SYSTEM

The PTWS uses the Hellfire missile system with a semiactive laser seeker. It is the primary armament of the AH-64 for the destruction of armor and other hard point targets. Depending on the tactical situation, the PTWS has a variety of user modes for selection. Its capabilities include day and night operations, onboard or remote designator use, single and multiple missile launches, and direct or indirect launches. The PTWS is fully integrated with the target acquisition and designation system. Missile inventory, status, and launch constraints are provided to the crew using the symbology set and alphanumeric display.

a. Hellfire Missile. The Hellfire missile weighs 99.5 pounds and is 64 inches long. Its diameter is 7 inches, and its wingspan is 13 inches.

b. Pilot's Missile Panel. The pilot's missile panel, located in the left-hand console, allows the pilot to employ the PTWS against a remotely designated target in either the LOBL or LOAL mode. The switch settings on the pilot's missile panel are as follows:

(1) The LOAL switch determines the employment mode of the PTWS. The OFF switch disengages the LOAL mode and defaults to the LOBL mode for missile launch. The DIR, LO, or HI switches activate the LOAL mode for missile launch. (Positions refer to missile trajectories following launch.)

(2) The LSR CODE switch is spring-loaded to the center position. It has two functions. First, it signals the validation and execution of related missile system switch positions. The exception is the LOAL switch, which is wired directly to the remote Hellfire electronics. Second, it establishes which channel setup, upper or lower, is assigned as the priority channel. If the missile system is in any mode other than normal (including STBY) when the pilot selects MSL on the WAS, the missile system will automatically switch to NORM.

c. Copilot/Gunner's Missile Panel. The CPG's missile panel, located in the left-hand console, allows the CPG to employ the PTWS against either autonomously or remotely designated targets in either the LOBL or LOAL mode or in both modes. The following indicators are part of the missile panel.

(1) The TYPE switch specifies which type of missile will be fired. LASER specifies that laser-seeker missiles will be fired. RF/infrared and IRIS advanced missile concepts are currently inactive.

(2) The MODE switch determines the operational mode of the PTWS. STBY places the

PTWS in the standby mode and initiates a BIT. NORM places the PTWS in the normal mode in which only priority channel missiles can be fired. RIPL places the PTWS in the ripple mode in which the RHE can automatically redesignate the priority channel from upper to lower and back to launch missiles on two different laser codes. MAN permits manual advance of missile selection instead of autoreplenishment.

(3) The MAN ADV push button, with the missile MODE switch in the MAN position, advances the missile selection manually. The CPG's LOAL switch functions the same as the pilot's LOAL switch.

d. CPG's Fire Control Panel. With the CPG's fire control panel, the CPG can activate the PTWS. He can also select missile quantities and codes, the priority channel, and laser counter-countermeasures.

(1) **MSL switch.** When in the ON position, the MSL switch commands the BUS controller to establish communications with the RHE, thus activating the PTWS. A BIT will be initiated if the missile panel MODE switch is in the STBY position.

(2) **CHAN SEL switch.** The CHAN SEL switch is spring-loaded to the center position. The CHAN SEL switch signals the validation and execution of related missile system switch positions, except for the LOAL and RF ORIDE switches which are wired directly to the RHE. It also establishes which channel setup, upper or lower, becomes the priority channel. Once the CHAN SEL switch is actuated and the MSL switches are validated, any change in a missile system switch except the LOAL will be ignored until the CHAN SEL switch is again actuated.

(3) **LSR CODE indexers.** The two LSR CODE indexers, UPR and LWR, specify the alphabetic laser-code designator assigned to that channel setup. Positions are A through H.

(4) **QTY indexers.** Two QTY indexers, UPR and LWR, specify the number of missiles per channel to be encoded and brought to a ready state at one time (three missiles per channel maximum). Positions are 0 through 3. Selecting the quantity "0" will default to a quantity of "1" if missiles are available after filling the priority channel request.

(5) **LSR MSL CCM switch.** The LSR MSL CCM switch activates the counter-countermeasures function of the laser seeker.

(6) **RHE.** The RHE is functional when power is applied to the aircraft, when the DC ELEC and AC ELEC circuit breakers are in, and when either

crew member selects the SAFE or ARM position on his fire control panel.

(7) MSL switch. When the MSL switch of the fire control panel that has selected either SAFE or ARM is moved to the ON position, a signal is sent to the BUS controller which commands it to establish communications with the RHE. If the CPG's MODE switch is in the STBY position, the RHE will perform a BIT and provide results to the FD/LS.

e. Built-In Test. The BIT (Figure I-12) will first check the RHE for GO/NO-GO status. During the testing, the message "BIT IN PROGRESS" will be displayed in the weapon status section of both the

HAD and the AND. If the RHE is "GO," FD/LS will then test the pylon multiplex remote terminal units and launcher electronics for a valid communications link between the RHE and the missiles. If the RHE status is "NO-GO" or a combination of MRTU and launcher electronics failures are such that all launchers are "NO-GO," the FD/LS will announce "MSL FAIL" to the crew on the video displays.

NOTE: The symbol generator and video displays must be active to detect a continuously monitored FD/LS failure.

f. PTWS Launcher Status. The PTWS status/inventory display is depicted in Figure I-13. If at

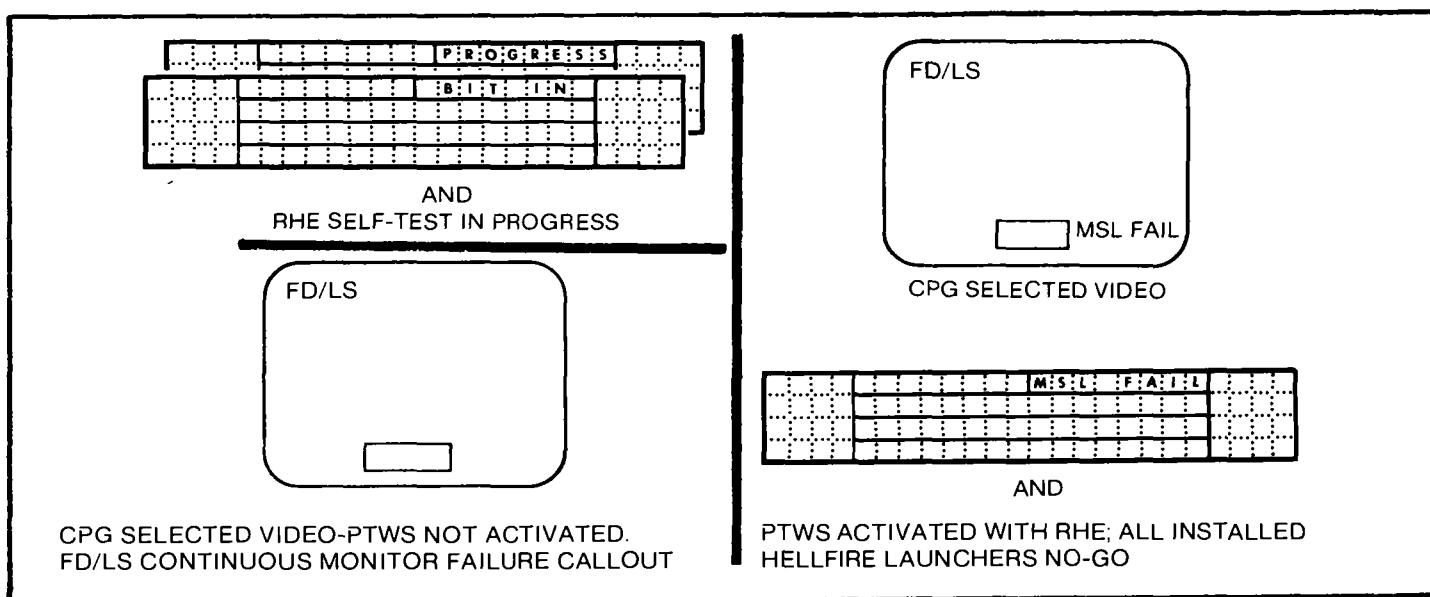
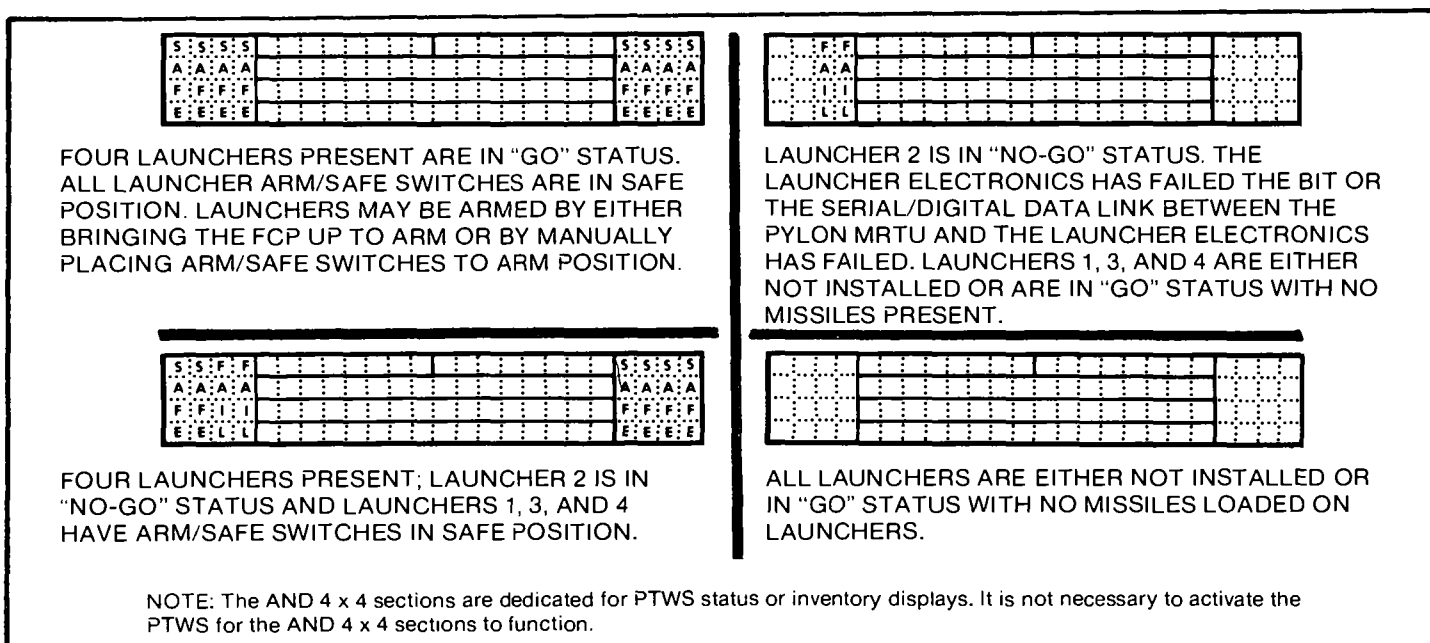


Figure I-12. Built-in test



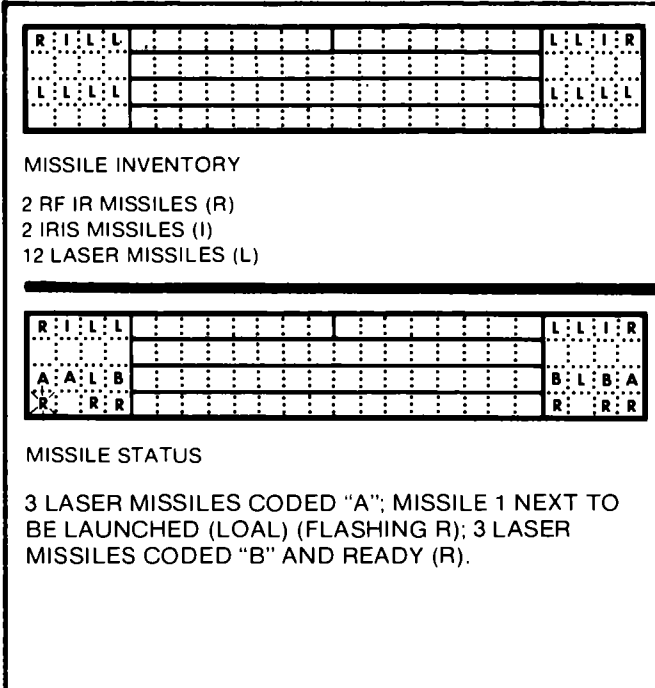
NOTE: The AND 4 x 4 sections are dedicated for PTWS status or inventory displays. It is not necessary to activate the PTWS for the AND 4 x 4 sections to function.

Figure I-13. PTWS status/inventory display

least one launch station (launcher electronics and pylon MRTU) is "GO," the status is displayed in the appropriate portion of the AND 4 x 4 sections for all launch stations.

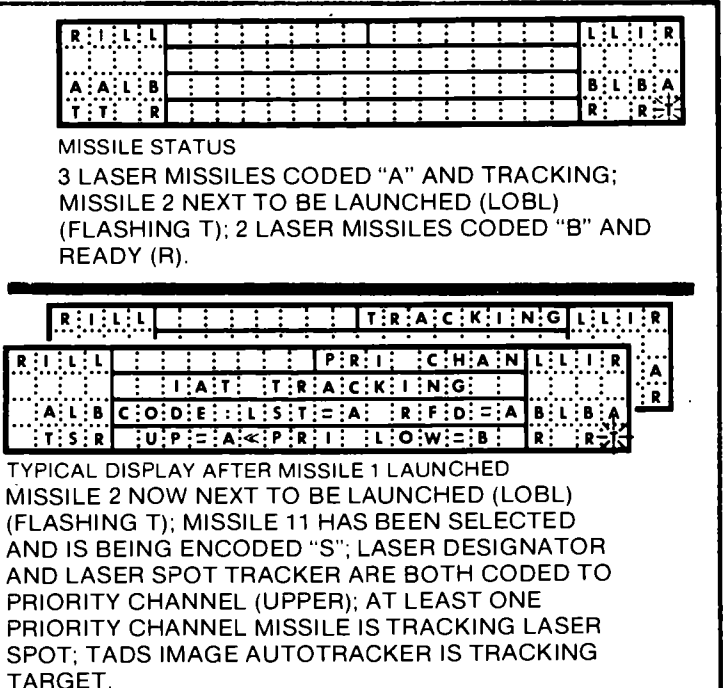
g. Missile Status And Inventory.

(1) Based on the type and status of a missile



(Figure I-14), characters are displayed in the AND 4 x 4 sections. The single status characters are displayed below the inventory or code characters. The multiple character status indicators use both positions.

(2) The status of all missiles is continuously displayed on the AND. The types of missile failures



INVENTORY/
CODE
CHARACTER

L
I
R
A through H

STATUS
CHARACTER

DESCRIPTION

Laser missile
IRIS missile
RF infrared missile

Code of the laser
missile in place of
the "L" indication.

S

The missile has been
selected manually or
by the RHE automatic
selection process.

R
(steady)

The missile is encoded
and ready for
employment.

R
(flashing)

The LOAL priority
channel shows the
missile that will be
launched next.

T
(steady)

The missile seeker is
locked on an appro-
priately coded laser
spot and is tracking.

T
(flashing)

The LOBL priority
channel shows the mis-
sile that will be
launched next.

Figure I-14. Missile status and inventory

that will prevent missile launch are depicted in Figure I-15.

NOTE: Missiles that reflect R or T (steady or flashing) on the same side of the helicopter as a missile that is hangfiring will reflect this status for six seconds from the onset of hangfire and will be inhibited from launch for this period of time.

h. CPG PTWS Messages. The PTWS messages in Figure I-16 can be presented to the CPG. The messages are defined in TM 55-1520-238-10, Chapter 4.

i. Pilot PTWS Messages. The PTWS messages in Figure I-17 can be presented to the pilot. The messages are defined in TM 55-1520-238-10, Chapter 4.

j. Missile Constraints Symbols. When the pilot activates the PTWS, he will see constraint symbology (Figure I-18) on the helmet mounted display. However, when the CPG activates the PTWS, constraint symbology will be presented to both crew members. The symbology indicates when all launch constraints have been satisfied.

(1) Before launch constraints are satisfied, the open (or dashed) out-of-constraints box will be displayed. The LOAL box represents 7.5 by 7.5 degrees; the LOBL box represents 20 by 20 degrees. The weapons trigger may be pulled to the second detent to launch the missile; however, safety constraints cannot be overridden.

(2) The symbology is directional. The pilot steers the helicopter toward the symbology.

(3) When all constraints are met, the dashed lines of the box become solid. The missile should be launched at this time; the box does not have to be around the target or LOS reticle.

k. Laser Missile Engagements. The firing modes are single, rapid, and ripple fire. They are defined as follows:

(1) **Single fire.** In the single fire mode, one missile is launched at one target. There will be only one missile in flight at any time.

(2) **Rapid fire.** In the rapid fire mode, laser-guided missiles are launched against multiple targets using a single laser-designator code. This

ALPHANUMERIC DISPLAY	
STATUS CHARACTER	DESCRIPTION
M U	The missile is unlatched on the launcher.
M F	The missile has failed the BIT or missile failure has been detected subsequent to BIT.
S F	The missile launch station on that launcher has failed.
T F	The pylon MRTU cannot communicate with the selected missile. Once detected for one missile on that launcher, all missiles on that launcher will reflect this status. This fault may be cleared by cycling the MODE switch to STBY and then back to desired position.
N A	The missile is not available or is low on coolant, or a hangfire is in progress.
M A	The launch sequence has aborted because the missile has misfired. Safety and ordnance disposal procedures for misfired or malfunctioning ordnance should comply with the SOP.
M H	The missile is hangfiring or has hangfired. Safety and ordnance disposal procedures for misfired or malfunctioning ordnance should comply with the SOP.

Figure I-15. Missile failure Indicators

HIGH ACTION DISPLAY		ALPHANUMERIC DISPLAY SIGHT STATUS
SIGHT STATUS	WEAPON STATUS	
LASE 1 ... TARGET LASE 2 ... TARGET LASE 3 ... TARGET TOF = 16	CPG MSL MSL FAIL INVALID ... COMMAND BIT IN ... PROGRESS HANGFIRE MSL LNCH TOF = 16 FIRE ... MISSILES SIM ... LAUNCH RF ORIDE 2 CHANLS ... TRACKING PRI CHAN ... TRACKING ALT CHAN ... TRACKING LASE 1 ... TARGET LASE 2 ... TARGET LASE 3 ... TARGET PMSL	MSL FAIL INVALID ... COMMAND NO TYPE BIT IN ... PROGRESS PLT MSL HANGFIRE MSL LNCH FIRE ... MISSILES SIM ... LAUNCH TOF = 16 RF ORIDE 2 CHANLS ... TRACKING PRI CHAN ... TRACKING ALT CHAN ... TRACKING (DELIVERY MODE) HI-LO-DIR-LOBL (FIRING MODE) STBY-NORM-RIPL-MAN

Figure I-16. CPG PTWS messages

HIGH ACTION DISPLAY	
SIGHT STATUS	WEAPON STATUS
UP=A LO=B	CPG MSL HANGFIRE RF ORIDE

Figure I-17. Pilot PTWS messages

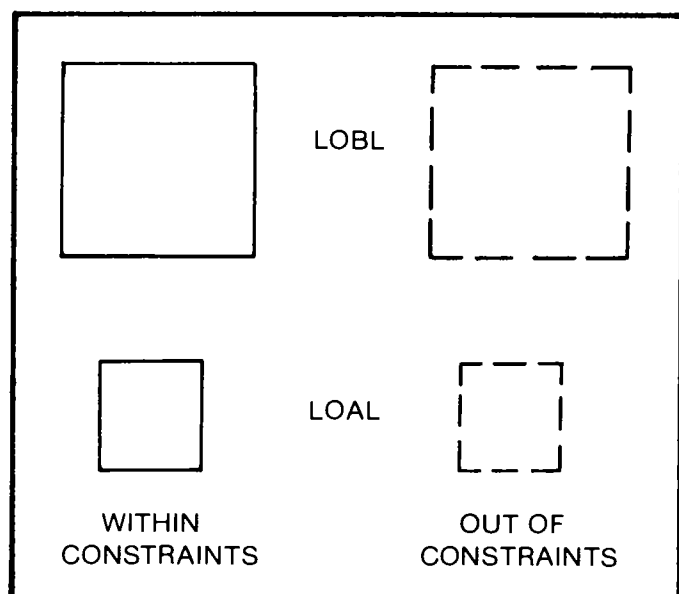


Figure I-18. Missile constraints symbols

mode requires a time between launches for minimum guidance; the time depends on range to targets and target separation.

(3) *Ripple fire.* In the ripple fire mode, multiple-laser missiles receive different laser codes so they can simultaneously engage two targets illuminated by two laser designators; each one is coded for each missile channel. Ripple fire of the missiles is sequential; the priority-coded missile is launched first. In the NORM mode, the time between launches depends on how quickly the operator can change the laser code priority and command the next missile launch. If the RIPL mode is selected, the PTWS automatically changes the priority channel after each missile launch so the CPG can launch the next missile two seconds after the preceding one. When two missiles on different codes are in flight at the same time, the HAD and AND messages for the priority channel missile will be displayed in the weapon status section. The alternate channel missile messages will be displayed in the sight status section. When the missile code of the priority channel and the code of the LRF/D are the same, when the TADS is the selected sight, and when the laser is being fired, then an autonomous designation situation exists. Autonomous designation missile prompts are shown in the weapon status section. Remote designation missile prompts are shown in the sight status section.

1. **Backscatter.** Backscatter is depicted in Figure I-19. Under normal conditions during a LOBL engagement, the missile seeker LOS will coincide with the TADS LOS.

(1) If an obscurant is between the TADS and the target, it is possible for the seeker to lock on the reflected laser energy from the obscurant and "walk up" the laser beam toward the aircraft. When the seeker LOS is two degrees from the TADS LOS and the seeker is locked on the

autonomous laser spot, the symbology will indicate "OUT OF CONSTRAINTS."

NOTE: This is only correct in this case if the aircraft is pointing directly at the target.

(2) To eliminate a backscatter lock-on, lasing the target should be discontinued for a short period of time and the target redesignated. If a backscatter problem still exists, it may be necessary to discontinue lasing, move to another position, and redesignate the target.

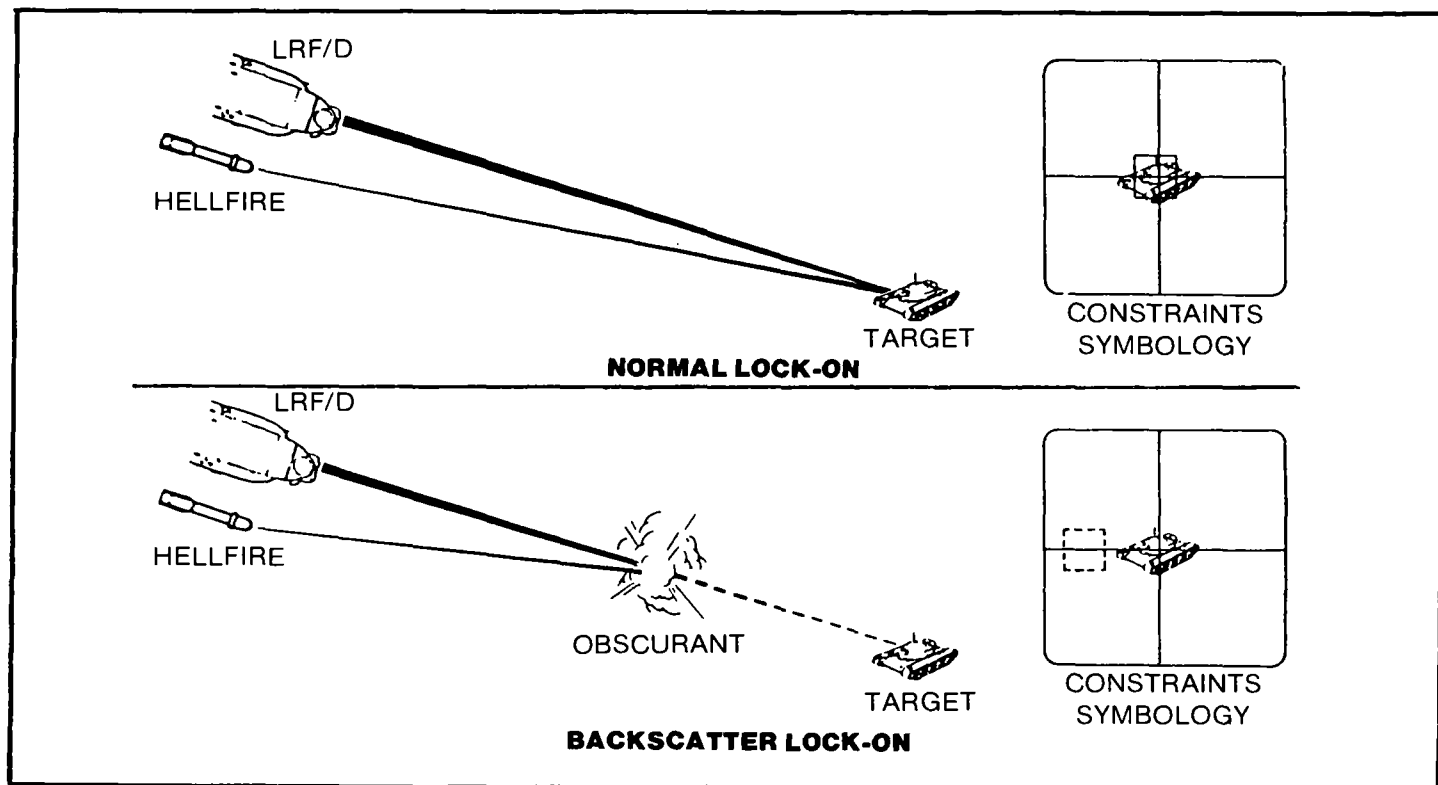


Figure I-19. Backscatter

Section II

TRACKING, WAY-POINT/ TARGETING, AND TARGET RANGE FIRING PROCEDURES

I-12. TRACKING PROCEDURES

There are three methods of tracking. They are manual tracking, image autotracking, and IAT offset tracking.

a. Manual Tracking. Manual tracking is depicted in Figure I-20. Initial positioning of the TADS may be accomplished by slaving the TADS to either the CPG's IHADSS LOS or to an LOS or a position as shown on the ACQ SEL switch.

(1) To slave the TADS to his IHADSS LOS, the CPG sets the SIGHT SEL switch to the HMD/ TADS position and momentarily presses the SLAVE push button on the RH grip. The IHADSS is the sight for weapons pointing and target engagement.

(2) To slave the TADS to an acquisition source, the CPG puts the SIGHT SEL switch into the TADS position, selects the acquisition source on the ACQ SEL switch, and momentarily presses

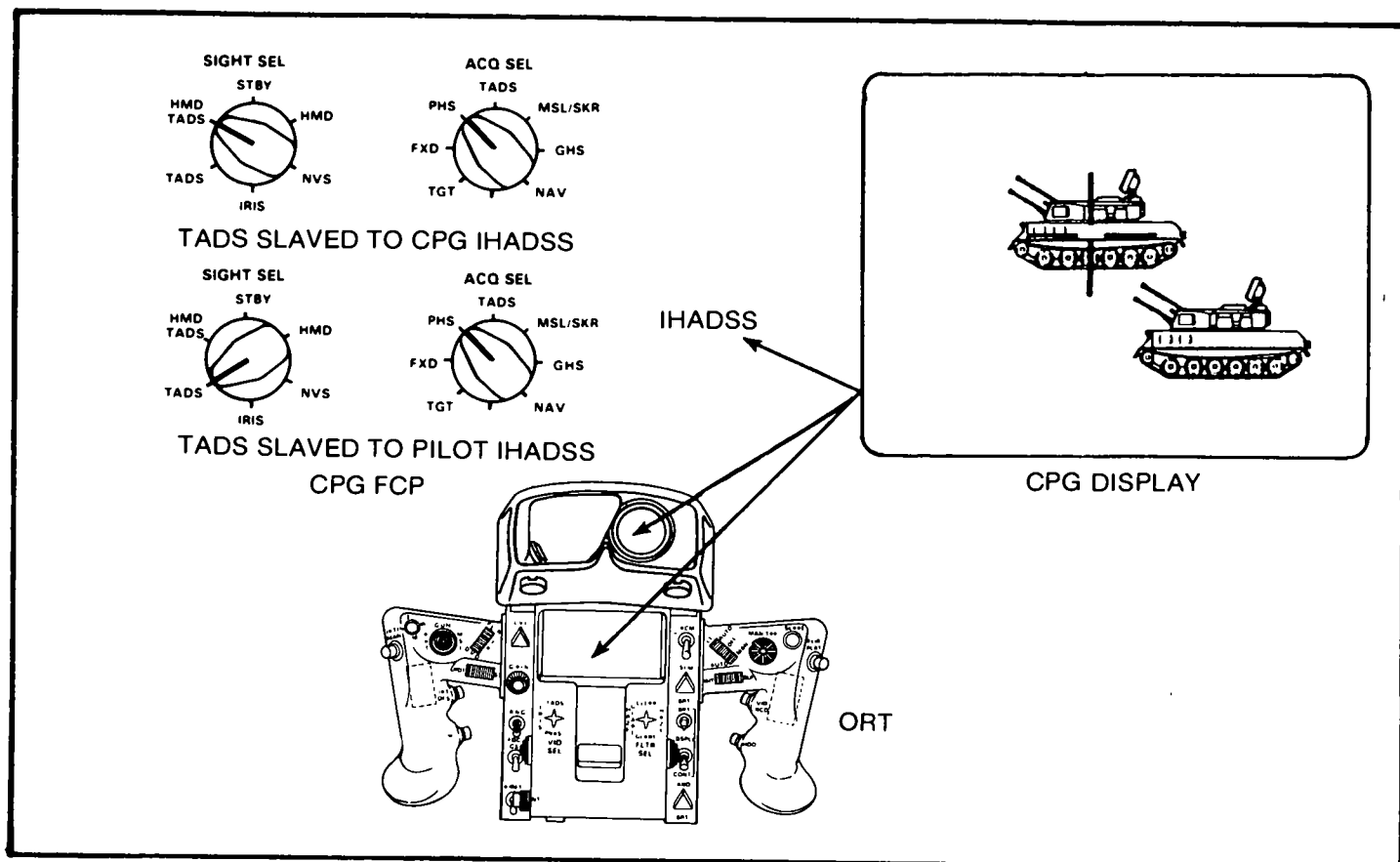


Figure I-20. Manual tracking

the SLAVE push button on the RH grip. When the TADS is slaved, the MAN TKR controller is disengaged.

(3) To unslave the TADS, the CPG again momentarily depresses the SLAVE push button. The TADS will unslave and inertially stabilize at its last commanded position, and the MAN TKR controller will be engaged.

(4) To track the target, the CPG can apply pressure on the controller; the greater the pressure, the faster the TADS LOS slew rate. Forward pressure will depress the LOS; aft pressure will elevate the LOS. Left pressure will slew the LOS to the left; right pressure will slew the LOS to the right.

(5) To reduce his work load while tracking a target, the CPG may momentarily press the LMC push button on the LH grip. If the target is stationary, the LMC will compensate for aircraft motion. If both the target and the aircraft are moving, the LMC will provide rate aiding.

b. Image Autotracking. With the IAT, the CPG tracking work load decreases and tracking

accuracy increases. Image autotracking is depicted in Figure I-21.

(1) To engage the IAT while tracking the target, the CPG momentarily presses the IAT/MAN push button on his LH grip. This disengages the MAN TKR controller. The IAT polarity switch is on the RH grip so the CPG can select white on black, black on white, or automatic. Direct selection of polarity is preferred to auto-polarity. The selected polarity will be displayed in the tracker status section of the AND as "IAT W/B," "IAT B/W," or "IAT AUTO."

(2) Once the IAT locks on the target, the tracking gates will remain stationary around the area of highest contrast. The message "IAT TRACKING" will then be displayed.

(3) If the IAT breaks lock because of loss of contrast or for any other reason, the tracking gates will move back toward the LOS reticle to capture the target. The message "IAT BREAK-LOCK" will be displayed. If the target moves behind an obscuration, the IAT will continue to coast in the same direction at the same rate for 0.6 second before it will break lock. The IAT may also break

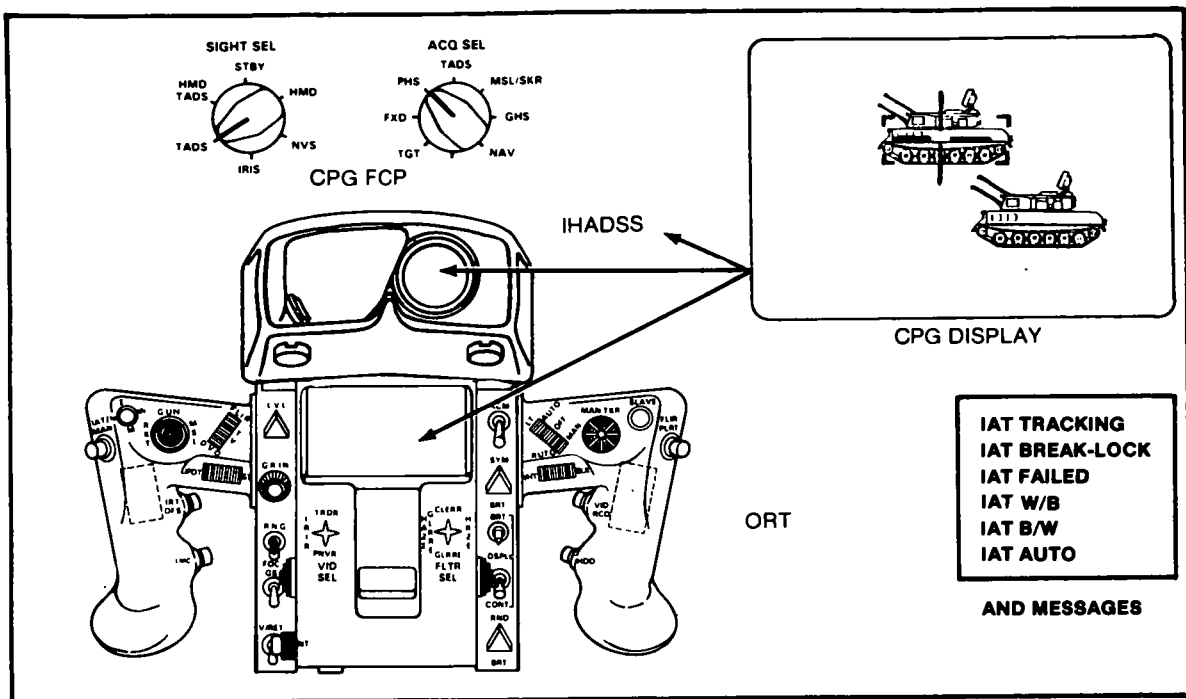


Figure I-21. Image autotracking

lock if the target gets too big in the selected FOV or under certain conditions when sensors or FOVs are changed.

(4) To disengage the IAT, the CPG again presses the IAT/MAN push button. The IAT messages and tracking gates will blank, and the MAN TKR controller will again be engaged.

c. IAT Offset Tracking.

(1) While image autotracking a target, the CPG can offset track the target (Figure I-22). He may—

- Track the first target and engage the second target so he can rapidly reacquire the first target.

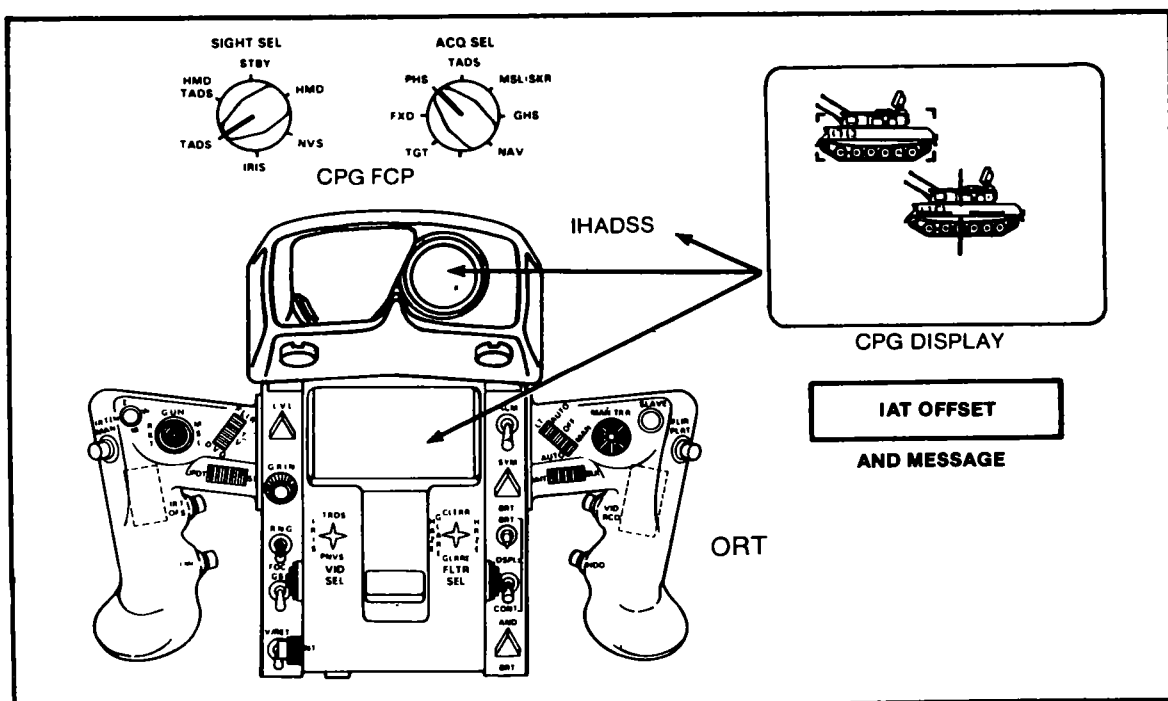


Figure I-22. IAT offset tracking

- Designate an object close to the target, denying the target time to detect that it is being designated.

(2) To offset track, the CPG momentarily depresses the IAT OFS push button on his LH grip. The MAN TKR controller will be engaged, and the CPG may move the LOS reticle to another object. The tracking gates will remain locked on the first target. The IAT may break lock if the target is too big in the selected FOV. During offset tracking, the message "IAT OFFSET" will be displayed in the tracker status section of the AND.

(3) To disengage offset tracking, the CPG presses the IAT OFS push button a second time. The MAN TKR controller is again disengaged. The LOS reticle will center within the tracking gates.

The "IAT OFFSET" message will blank, and normal IAT messages will be displayed.

I-13. WAY-POINT AND TARGETING PROCEDURES

Way-point and targeting functions are performed solely by the CPG; the pilot cannot actively participate. Four functions can be implemented: preflight, storing, position update, and cueing.

a. Preflight Procedures. Preflight procedures are depicted in Figure I-23. The way-point and targeting functions require the CPG to enter certain data (during run-up) under the SP1 position of the DEK selector switch. This data is displayed as shown in Figure I-23.

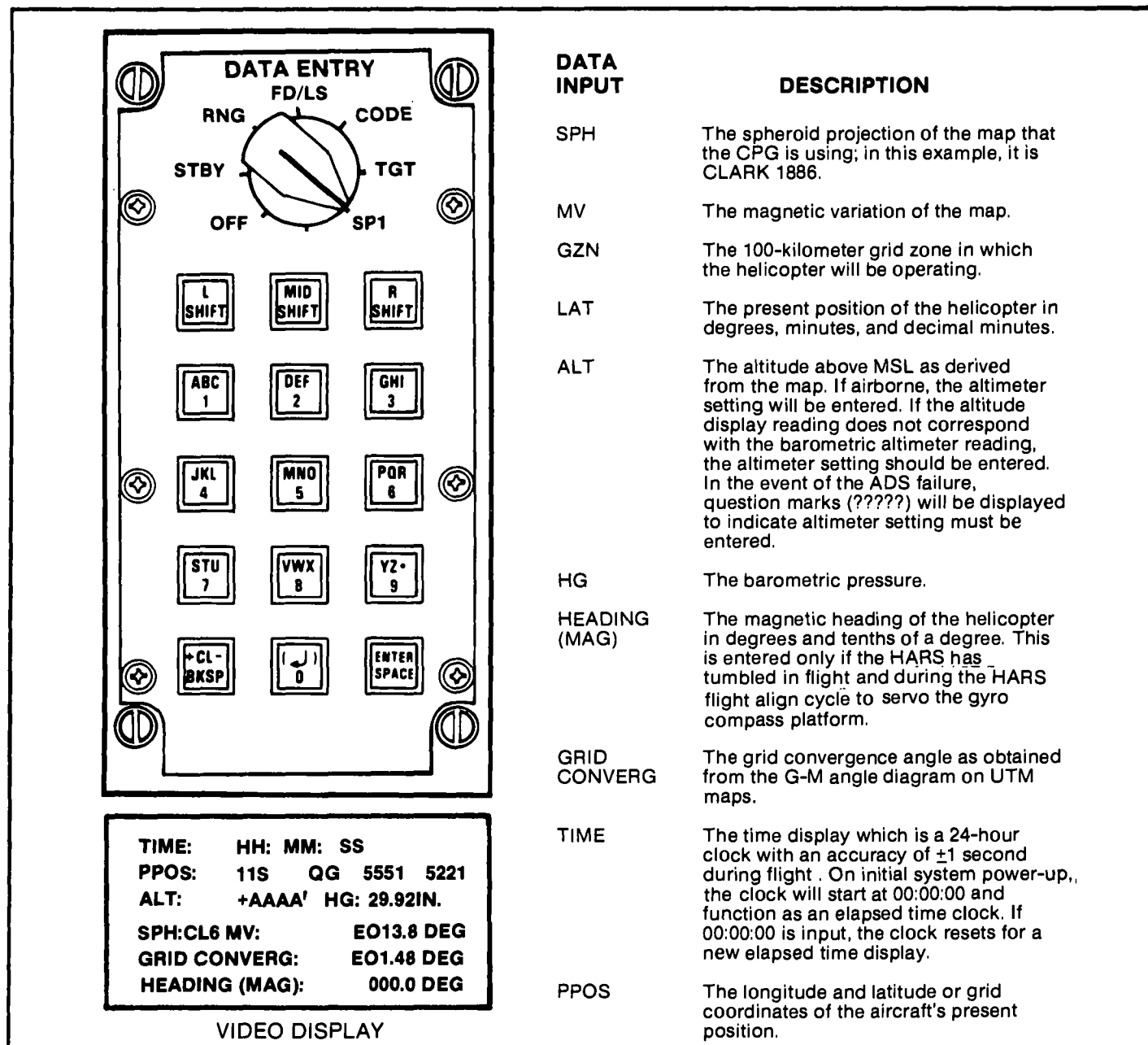


Figure I-23. Preflight procedures

b. Coordinate Data Storing. Up to 10 sets of coordinate data may be stored in the FCC at any time (Figure I-24). Coordinate data can be stored in two ways: via the DEK and via the store switch.

(1) Storing via the DEK. To store coordinate data via the DEK, place the selector switch in the TGT position. The data is displayed as four pages of a coordinate data menu and may be scrolled by using the SPACE KEY on the DEK.

(a) Locations that contain no stored data will display the message "NO DATA." To clear locations that contain data, enter the letter "C" followed by the location number and then enter SHIFT ENTER. To clear multiple locations, enter the letter "C" followed by the number of all locations to be cleared and then enter SHIFT ENTER. Once cleared, the locations will display "NO DATA."

(b) To enter the data, first input the appropriate coordinate address. The cursor will jump to the first position for data entry such as "ARID ZONE." Enter the appropriate data for that storage location.

(c) Press the SPACE key for automatic entry if the grid zone to be entered is the same as the helicopter's present position. The first three spaces are for the grid zone; in this case, it is location 0,11S. The cursor will advance to the first character of the 100-kilometer identification. Either input the data or use automatic entry as for the grid zone. Then, enter either the six- or eight-digit coordinates.

(d) Press the SPACE key again to automatically enter "A" for altitude. If the altitude of coordinates is above MSL, enter the numbers. It may be necessary to add a leading zero or zeros. If altitude is below MSL, enter a minus sign before the value.

(2) Storing via the store switch. During a mission, targets of opportunity may be encountered. The CPG may store (Figure I-25) the location of these targets for later engagement or for reporting to higher headquarters or other airborne elements. Since these sightings may be fleeting, using a map to pinpoint their coordinates is not very effective.

(a) Using the TADS, the helicopter can calculate these target locations based on the present position. To store the data, select the storage location by using the TGT/NAV indexer. Enter the range to the target or way point. Manual range is entered via the DEK with the selector switch in the RNG position. This is automatically calculated using the selected LOS. Laser range is entered by placing the LOS reticle on the target or way point and firing the laser. Place the LOS

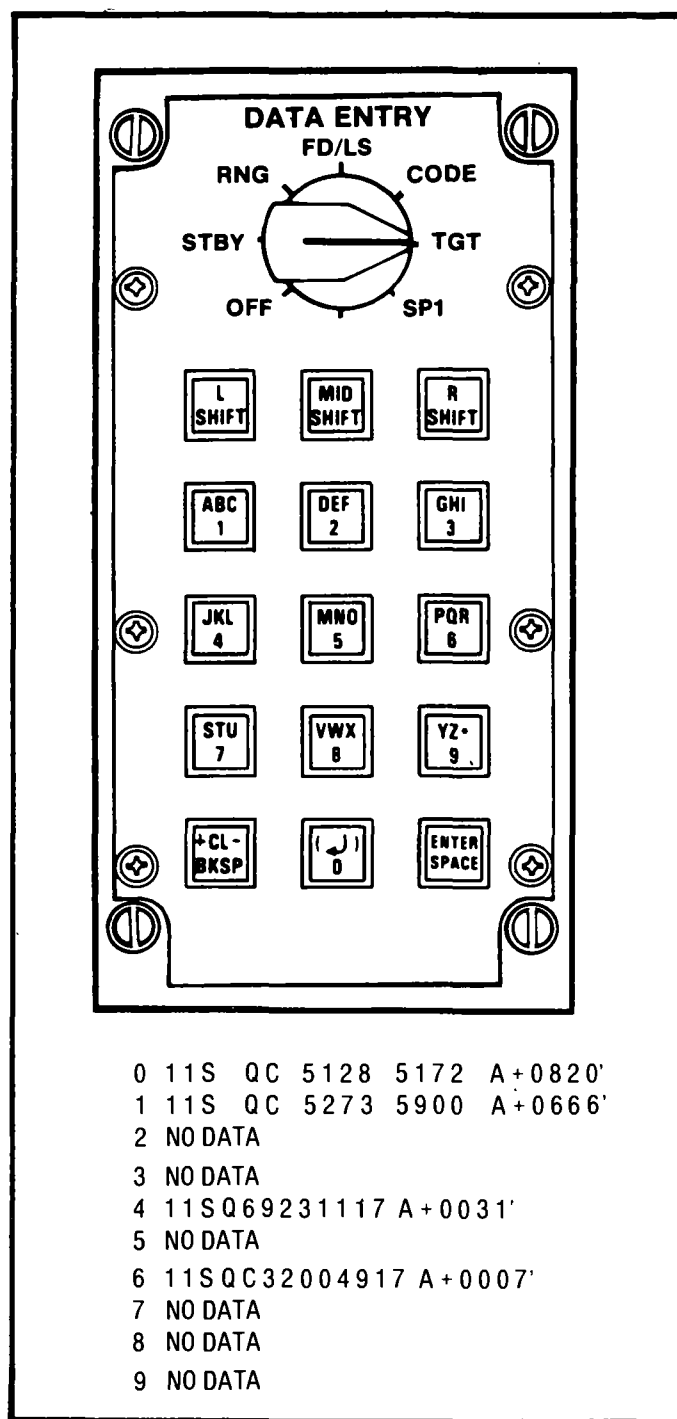


Figure I-24. Storing Procedures 1

reticle of the selected sight on the target or way point and momentarily set the UPDT/ST switch on the ORT LH grip to the ST position. The FCC will calculate coordinates and store them in the selected location.

(b) The coordinates may be recalled by placing the DEK selector switch in the TGT position. Scroll the display until the desired position is reached.

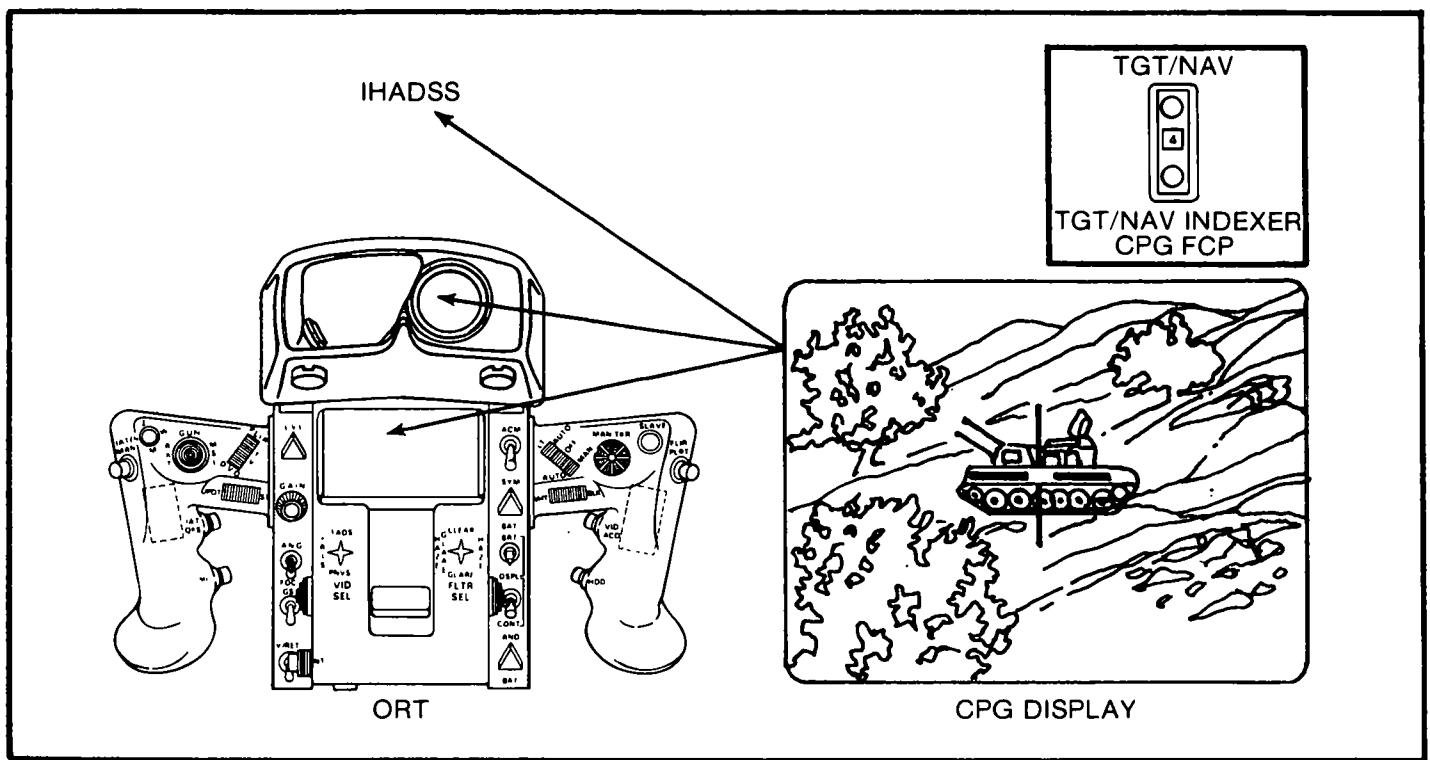


Figure I-25. Storing procedures 2

c. Position Update. This procedure calculates the present position of the helicopter (Figure I-26) based on previously stored coordinate data. The updated position is not stored within the FCC or automatically sent to the Doppler.

(1) To update the helicopter's present position—

- Set the TGT/NAV indexer in the position of the previously stored coordinate data.
- Enter the range from the helicopter to the object of the coordinate data. These procedures are in paragraph I-13b.
- Place the selected sight LOS reticle on the object or feature of the previously stored coordinate data.
- Momentarily set the UPDT/ST switch to the UPDT position. The FCC will compute the present position.

(2) To recall the updated present position, put the DEK selector switch in the SP1 position and press the "U" key. The updated position will automatically be displayed. It will show coordinate and northing and easting errors of the Doppler. An example of the display is given in Figure I-26.

NOTE: The coordinates are present position. The Doppler easting error is +65 meters, and the Doppler northing error is -12 meters.

(3) To update the Doppler, immediately recall the updated present position and enter it into the Doppler via the CDU keyboard. If the index location entered is not the same as the index location updated from the message, "ERROR" will be displayed. If the updated coordinates were not previously stored, an attempt to recall the updated position will result in "NO DATA" being displayed.

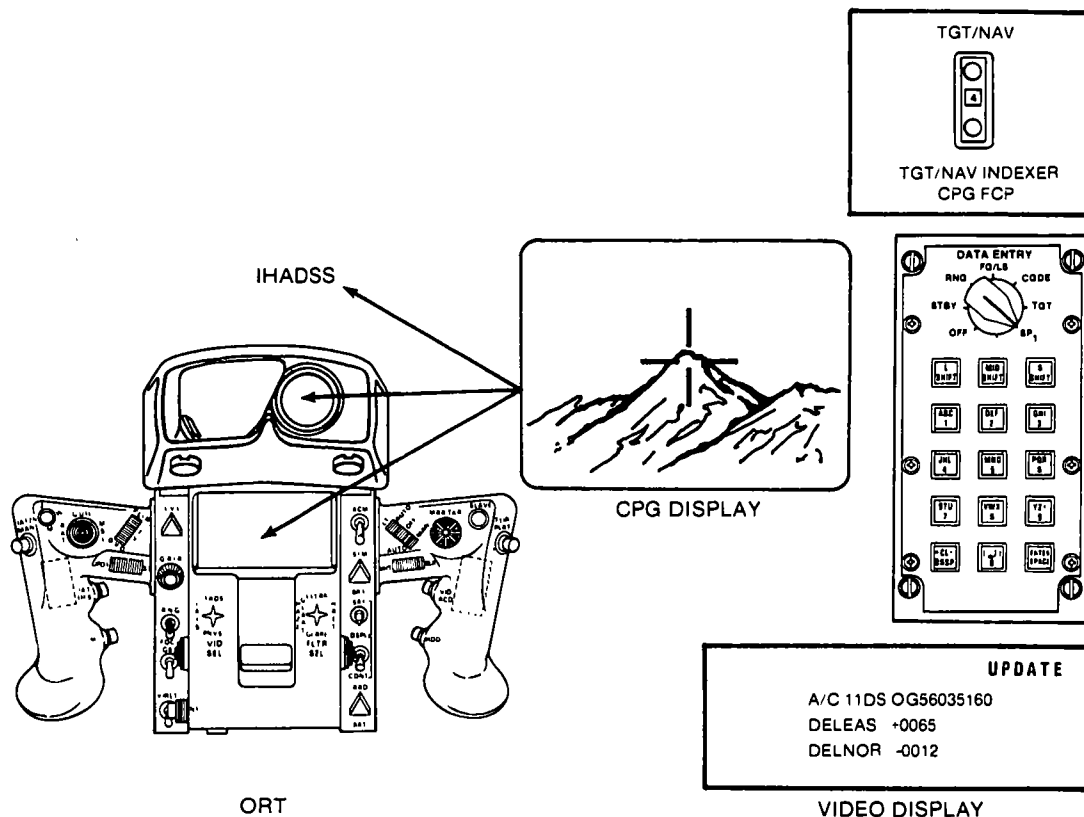
d. TADS Slaving or Cueing. Once way-point or targeting data has been stored, line-of-sight TADS slaving or cueing (Figure I-27) to the stored coordinates can be accomplished as follows:

(1) **Slaving.** To slave the TADS—

- Position the SIGHT SEL switch to the TADS position.
- Position the ACQ SEL switch to either the TGT or NAV position.
- Select stored coordinates to be slaved using the TGT/NAV indexer.
- Ensure that target coordinates will be within the TADS FOV if within the TADS gimbal limits.

(2) **Cueing.** To cue the TADS—

- Set the SIGHT SEL switch for any position except TADS or IRIS.
- Set the ACQ SEL switch to the TGT or NAV position.



NOTE: The coordinates are present position, the Doppler easting error is +65 meters, and the Doppler northing error is -12 meters.

Figure I-26. Position update

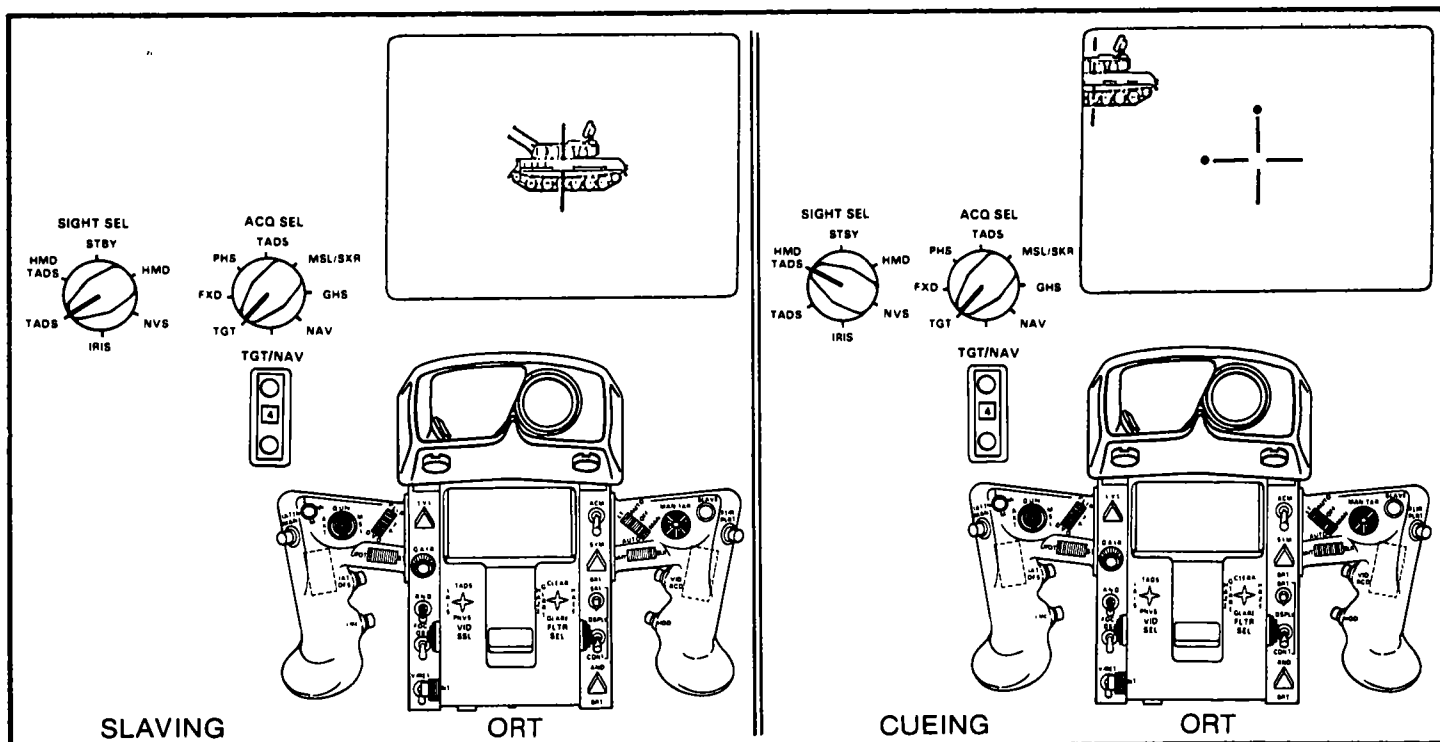


Figure I-27. TADS slaving or cueing

- Select stored coordinates of the object to be cued using the TGT/NAV indexer.
- Press the ORT RH grip SLAVE push button. Cueing symbology will be displayed to cue the CPG's LOS to the coordinate line of sight.

(3) Recalling range and bearing. To recall range and bearing from the helicopter to the stored coordinate data, set the DEK selector switch for the TRGT position and enter "Rn." The "n" represents the stored coordinate storage address. The range and bearing data will be displayed as in the example shown in Figure I-28. If no data is stored in the requested address, the message "NO DATA" will be displayed. The maximum range for recall is 32 kilometers.

R3 15990 B042 DEG 26 MIN

R3 is the storage address.

15990 is range to coordinate data in meters.

B042 DEG 26 MIN is bearing to the coordinate data, 42 degrees, 26 minutes.

NOTE: Information is valid only for present location.

Figure I-28. Range and bearing data

I-14. TARGET RANGE PROCEDURES

The area weapon system and aerial rocket control systems require accurate range input for optimal operation. Range may be input to the FCC in one of four ways. Range and range source information will be shown on the high action displays.

a. Laser Range Finder. The laser range finder provides the most consistently accurate range input. When the laser trigger is pulled to the first detent, the laser gives three pulse bursts and stops; range is updated for six to seven seconds, based on aircraft movement after the laser trigger is released. When the trigger is pulled to the second detent, the laser fires continuously. The laser range has priority over other range inputs.

b. Automatic Range. The automatic range uses the LOS look-down angles from the IHADSS or TADS and altitude from the radar altimeter to mathematically determine range to the target. This method does not consider curvature of the earth or variations in target altitude that may decrease accuracy. Additionally, when operating at low altitudes, small changes in look-down angles generate significant changes in range. When using IHADSS, small head movements may cause large dispersions, especially with the AWS. For automatic range, "A" is selected on the left range thumb wheel of the rocket control panel or "O" range is entered on the DEK.

c. Manual Range. Manual range is input through the rocket control panel or DEK. The range used should be the most accurate range available. If target grid is known and present position is accurate, the grid may be input as a target location using the DEK and recalled as a range and azimuth by inputting "Rn." For IHADSS LOS, the recalled range must then be input manually into the rocket control panel or DEK.

d. Navigation Range. NAV range requires that target location be stored in the FCC. The stored target number should be placed in the TGT/NAV indexer and the ACQ SEL switch set to TGT or NAV. The FCC will use range computed from the present position to the target.

Section III

WEAPON SYSTEM EMPLOYMENT

I-15. PREFLIGHT PROCEDURES

Employment of the AH-64 weapon system begins during preflight. Before employing the AH-64, check the quantity, type, and zone location of the 2.75-inch FFAR missiles. Then set the zone inventory selection switches on the rocket control panel. Improper settings confuse the crew and cause improper ballistics to be applied to the rockets. Check the quantity of 30-millimeter ammunition. Then set the rounds counter in the

left FAB to the power required. Finally, set the burst limiter on the gun control box in the right FAB to the desired burst limit.

I-16. SYSTEMS OPERATIONAL CHECKS AND BORESIGHT PROCEDURES

Checks and procedures will be conducted according to the operator's manual checklist. All sight/sensor systems must be activated once the APU has been

started and electrical power is available. Ensure the present position, magnetic variation, and grid convergence are current and entered in the FCC using the SP1 position of the DEK. Then begin HARS alignment. Ensure that all current mission/target data and laser codes are entered into the FCC through the DEK. Enter the route way-point data into the Doppler CDU. The pilot and CPG will perform IHADSS boresight procedures. The CPG will also perform TADS operational checks and internal and outfront boresight procedures as required.

I-17. WEAPONS INITIALIZATION

Either before or shortly after takeoff, the pilot and CPG will initialize all weapon systems to verify proper indications and arrange weapon switches in preparation for possible target engagements. The following procedures are recommended:

a. Pilot.

(1) ARCS.

(a) MASTER ARM—SAFE. Position the MASTER ARM switch to SAFE.

(b) RKT select—NORM. There is no immediate indication of this action unless the rocket system is detected as NO-GO. The ROCKET segment on the C/W panel will then illuminate.

(c) ARCP switches—as desired. Verify zone inventory and quantity remaining indications; set PEN-M, QTY, and RNG-KM switches as desired.

(d) Cyclic WAS—R, then deselect. Momentarily position cyclic WAS to R, and verify appropriate messages and symbology. Then deselect the rockets.

(2) AWS.

(a) GUN select—NORM. There is no immediate indication of this action unless the gun system is detected as NO-GO. The GUN segment on the C/W panel will then illuminate.

(b) Cyclic WAS—G, then deselect. Momentarily position the cyclic WAS to G, and verify appropriate messages and symbology. Then deselect the gun.

(3) PTWS.

(a) MSL select—ON. Position the MSL SEL switch to ON.

(b) MASTER ARM—ARM, then SAFE. Coordinate with CPG to bring the launcher SAFE/ARM switch to the ARM position.

(c) Cyclic WAS—M, then deselect. Momentarily position the cyclic WAS to M, and

verify appropriate messages and symbology. Then deselect the gun.

b. Copilot/Gunner.

(1) ARCS.

(a) CPG ARM switch—SAFE. Position the CPG ARM switch to SAFE.

(b) RKT select—NORM. There is no immediate indication of this action unless the rocket is detected as NO-GO. The ROCKET segment on the C/W panel will then illuminate.

(c) ORT LHG WAS—RKT, then deselect. Position WAS to RKT, and verify appropriate messages and symbology. Then deselect the rockets.

(2) AWS.

(a) GUN select—NORM. There is no immediate indication of this action unless the gun system is detected as NO-GO. The GUN segment on the C/W panel will then illuminate.

(b) ORT LHG WAS—GUN, then deselect. Position WAS to GUN, and verify appropriate messages and symbology. Then deselect the gun.

(3) PTWS.

(a) UPR/LWR CHAN LSR CODE—as desired. Select the desired UPR/LWR CHAN LSR code.

(b) UPR/LWR CHAN QTY—as desired. Select the desired UPR/LWR CHAN QTY.

(c) TADS LSR CODE LST-LRF/D—as desired. Select the desired TADS LSR CODE LST-LRF/D.

(d) MSL TYPE switch—LASER. Position the MSL TYPE switch to LASER.

(e) MSL MODE—STBY. If the BIT is to be performed, place the MODE switch to STBY. If the BIT is to be bypassed, place the MODE switch as desired.

(f) LOAL switch—as desired. Position the LOAL switch as desired.

(g) MSL select—ON. If the BIT is performed, it takes 0.8 second to perform the BIT on the RHE, an additional 8.0 seconds to perform the BIT on all four launchers, and an additional 32.0 seconds to perform the BIT on a set of four missiles. During this time, the message "BIT IN . . . PROGRESS" will be displayed to the CPG in the weapon status section of both the HAD and the

AND. When the BIT is completed, the message will blank.

(h) MSL MODE—NORM/RIPL/MAN. The switch must be moved out of STBY to CHAN SEL.

(i) CHAN SEL—UPR/LWR. Position the CHAN SEL switch to UPR/LWR.

(j) MASTER ARM (pilot)—ARM, then SAFE. If a launcher SAFE/ARM switch is in the SAFE position, the 4 x 4 section for that launcher will indicate "SAFE" in the AND. To remove the "SAFE" indication, either the CPG or pilot must momentarily take his fire control panel to ARM to move the switch to the ARM position.

(k) ORT WAS—MSL, then center position. Verify appropriate missile messages and symbology. Then deselect the missile system.

(l) LASER select—ON. The laser is powered; however, the laser cannot be fired until the fire control panel is in an ARM condition. The laser trigger is not controlled by the WAS.

NOTE: Once a channel is designated as the priority channel, the RHE will select, spin up, and encode the quantity of missiles as set up on the fire control panel. This status will be displayed in the AND if the launcher ARM/SAFE switch is in the ARM position. WAS action is not required for the display.

I-18. TARGET ACQUISITION

a. Detection. The DVO, DTV, and FLIR provide a significant variety of detection capabilities and range of conditions. These conditions include night and adverse weather.

(1) The DVO uses an optical telescope with a real-world, wide field-of-view color image, which provides excellent detection capability. The DVO is usually limited to short-to-medium ranges because of its limited magnification along with the effects of dust and smoke.

(2) The DTV tracks and detects effectively because of its high magnification. Since it operates in the near-infrared range, it is particularly useful in dust and smoke or in camouflaged areas.

(3) The FLIR is particularly suitable for night operations and conditions of limited visibility. However, since infrared energy is attenuated by moisture, FLIR operations may be degraded in rain or fog.

(4) During day operations, the TADS is normally positioned FXD or DVO WFOV until needed for target engagement.

b. Acquisition.

(1) With the TADS, a number of methods enhance and speed up the CPG's acquisition task. The position of the SIGHT SEL and ACQ SEL switches on the CPG's fire control panel determines the method of acquisition. If the TADS is the selected sight, it will be slaved to the LOS of the selected acquisition source (PHS, GHS, MSL SKR, or TGT/NAV) when the SLAVE push button is pressed on the right-hand ORT grip. If the TADS is not the selected sight, the HDU is cued to the selected acquisition source LOS. With the HMD/TADS, the TADS will be slaved to the CPG's HMD and the HMD will be cued to the selected acquisition source. Care should be taken when HMD/TADS is used; the HMD is the selected LOS. If the AWS is fired in this mode with the TADS heads-down, the gun will follow the HMD LOS into the ground.

(2) Targets may also be acquired with the TADS way-point function. With TADS as the selected sight and TGT/NAV as the acquisition source, the selected target number should be placed in the TGT/NAV indexer and the TADS slaved. The FCC will compute the LOS to the target and point the TADS accordingly. The NAV range to the target is also computed and will be used for the fire control solution unless overridden by another range input. The target coordinates used may be previously stored in the FCC from a map inspection or from observer information. The coordinates might also be entered by acquiring the target with the TADS, inputting the range (laser range preferred), and momentarily selecting the ST position on the UPDT/ST switch on the left-hand ORT grip. The target coordinates will be automatically stored in the position selected in the TGT/NAV indexer. The latter method is the most accurate, especially if the accuracy of the aircraft's present position or target coordinates is doubtful.

(3) The LST can also acquire targets. The LST should be coded to the appropriate remote laser code and the CHAN SEL switch set. Then the remote designator should be directed to lase the target and the LST manual (TADS position drive by the CPG using the thumb force controller) or the LST AUTO/TADS selected. The AUTO/TADS setting causes the LST to automatically scan a 40-degree-wide, four-bar pattern that is centered around the point of engagement. If the scan pattern overlaps a TADS gimbal limit, the gimbal limit defines the lateral limits of the scan pattern and the center of scan will shift appropriately. When the LST receives the reflected laser energy from the remote designator, the TADS will stop with its LOS directed at the laser spot. The CPG may then disengage the LST and manually track the target. The LST and LRF/D cannot be used simultaneously if both are set to the same laser code.

c. Tracking.

(1) **Target tracking.** Target tracking is most often done in the narrow and zoom fields of view of the selected sensor. Tracking is done manually with the thumb force controller or automatically with the image autotracker. To use the IAT, the target in the sensor reticle must be centered; the image selected black on white, white on black, or autoselected, as appropriate to image scene; and the IAT engaged. The tracking gates will expand to enclose the target. The IAT should always be monitored closely. Manual control must be assumed if break-lock should occur. If the IAT is engaged when using the DVO, the IAT will track using the FLIR image. The FLIR must be on and properly adjusted. The IAT tracking gates will not appear in the DVO.

(2) **Offset tracking.** The LOS of the LRF/D may be offset from the TADS LOS by engaging IAT-OFS. Then the manual thumb force controller is set to displace the LRF/D LOS. Pressing the IAT-OFS a second time will automatically realign the LRF/D and TADS LOS. Offset lasing may be used when multiple missiles are fired with laser detection devices or when adequate target contrast is not available for the IAT.

(3) **LMC target tracking.** The LMC will compensate for lateral movement of the aircraft or target to maintain the TADS LOS on the target. The LMC also provides rate aiding. Without the LMC, the TADS will stop when the thumb force controller is released. With the LMC, the TADS will continue to slew at the last rate attained. Opposite controller force is then necessary to stop the TADS. The LMC works well at short-to-medium ranges. At long ranges, it may be too sensitive for precise manual control. The LMC also, with the IAT, can assist in tracking targets with high angular rates.

(4) **Tracking rates.** The sensitivity of the thumb force controller (tracking rates) corresponds to the field of view and sensor used; the narrower the FOV, the less sensitive the controller. If DVO are selected for viewing DTV heads-out, tracking rates will be DVO rates which may be too sensitive for precise tracking with DTV.

d. Laser Ranging and Designation.

(1) When the laser trigger is pulled to the first detent, the laser will fire three pulses and stop. The laser range is presented and updated for seven seconds, based on aircraft ground velocities.

(2) When the laser trigger is pulled to the second detent, continuous pulsed laser energy is available on the selected code for target designation. The laser range is presented and continuously updated. The laser range is available regardless of the LRF/D code.

(3) If the laser range readout is erratic or the readout is significantly different from the estimated range, the LSR CCM should be switched ON to receive the laser pulse logic. The target center of mass should be lased with the laser designator; laser energy cannot be allowed to spill over the top of the target.

(4) When the laser is shifted from one target to the next during multiple missile launches, it should be moved smoothly and laser energy should be kept on the ground.

I-19. AREA WEAPON SYSTEM FIRING PROCEDURES

a. Weapon firing will be conducted according to the operator's manual checklist. To operate the AWS in the *normal mode (pilot only)*, proceed as follows:

(1) **MASTER ARM—ARM.** Position the MASTER ARM switch to ARM.

(2) **GUN select—NORM.** Position the GUN select switch to NORM.

(3) **Cyclic WAS—G.** Momentarily position the cyclic WAS to G. The message "PGUN" will be displayed to the CPG in the HAD. The gun will slave to the IHADSS.

(4) **Acquire the target.** The LOS reticle indicates the point on the ground or target where the rounds will impact. The fire control systems adjust the gun pointing angle to compensate for range, aircraft movement, wind, and target movement. Place the LOS reticle on the target. The slew limits for the AWS are ± 110 degrees in azimuth and ± 11 degrees in elevation to -60 degrees in depression. The pilot default range is 3.0 kilometers.

(5) **Provide range to target.** Enter the range to the target or select autoranging using the RNG-KM thumb wheels on the ARCP.

(6) **WEAPONS trigger—press.** Ensure the range information and weapon control/status in the HAD are appropriate for the desired engagement before firing. Lift the protective cover over the cyclic trigger switch, and pull the trigger to the first detent. If the gun will not fire with the trigger in the first detent, pull the trigger to the second detent. As the gun fires, the rounds remaining display will count down as rounds are expended. The gun will fire until one of the following occurs:

- Ammunition supply is depleted.
- Burst limit is reached (set on turret control box).
- Trigger is released.
- Gun fails.

(7) Cyclic WAS—deselect G. When the desired quantity is expended or the target neutralized, deselect the gun. One of the following messages will be displayed to the pilot in the weapon status section of the HAD:

- **GUN FAIL**—the gun system has been detected as NO-GO.
- **SIGHT?**—the pilot's SIGHT SEL switch is in the STBY position.
- **LIMITS**—the gun system has reached an azimuth or elevation limit.
- **RNDS####**—the gun system is operational, and the number of rounds remaining will be displayed in the "####" spaces.

b. To operate the AWS in the *fixed mode (pilot only)*, proceed as follows:

(1) MASTER ARM—ARM. Position the MASTER ARM switch to ARM.

(2) GUN select—FXD. The gun will remain in the STOW position (+11 degrees elevation).

(3) Cyclic WAS—G. Momentarily position the cyclic WAS to G. The message "PGUN" will be displayed to the CPG in the HAD. The gun will move from the STOW position to +0 degree elevation and azimuth.

(4) Acquire the target. The cued LOS reticle indicates the computed rounds impact point. It will appear when the pilot's LOS is within 20 degrees of the armament datum line. Maneuver the helicopter until the cued LOS reticle is on the target.

(5) Provide range to target. Enter the range to the target manually or select autoranging using the RNG-KM thumb wheels on the ARCP.

(6) WEAPONS trigger—press. Ensure the range information and weapon control/status in the HAD are appropriate for the desired engagement before firing. Lift the protective cover over the cyclic trigger switch, and pull the trigger to the first detent. If the helicopter is on the ground, the CPG's PLT/GND ORIDE switch must be in the ORIDE position to fire the gun. If the gun will not fire with the trigger in the first detent, pull the trigger to the second detent. As the gun fires, the rounds remaining display will count down as rounds are expended. The gun will fire until one of the following occurs:

- Ammunition supply is depleted.
- Burst limit is reached.
- Trigger is released.
- Gun fails.

(7) Cyclic WAS—deselect G. When the desired quantity is expended or the target neutralized, deselect the gun. One of the following messages will be displayed to the pilot in the weapon status section of the HAD:

- **GUN FAIL**—the gun system has been detected as NO-GO.
- **SIGHT?**—the pilot's SIGHT SEL switch is in the STBY position.
- **RNDS####**—the gun is operational, and the number of rounds remaining will be displayed in the "####" spaces.

c. To operate the AWS in the *normal mode (CPG only)*, proceed as follows:

(1) CPG ARM—ARM. Position the CPG ARM switch to ARM.

(2) GUN select—NORM. Position the GUN select switch to NORM.

(3) Cyclic WAS—G or ORT LHG WAS—GUN. Select the gun system by either momentarily positioning the cyclic WAS to G or by positioning the ORT LHG WAS to GUN. The message "CGUN" will be displayed to the pilot in the HAD. The gun will slave to the CPG's selected sight, IHADSS, or TADS LOS.

(4) Acquire the target. The LOS reticle indicates the point on the ground or target where the rounds will impact. The fire control systems adjust the gun pointing angle to compensate for range, aircraft movement, wind, and target movement. Place the LOS reticle on the target. In this condition, the gun travel is limited to +11 degrees in elevation to -1.7 degrees in depression.

(5) Provide range to target. Provide the FCC with range data (laser, manual, autoranging, or TGT/NAV).

(6) WEAPONS trigger—press. Ensure the range information and weapon control/status in the HAD are appropriate for the desired engagement before firing. Lift the protective cover over the cyclic trigger switch or the ORT LHG trigger switch, and pull the trigger to the first detent. If the helicopter is airborne, the gun will fire and the rounds remaining display will count down as rounds are expended. If the helicopter is on the ground, the CPG's PLT/GND ORIDE switch must be in the ORIDE position to fire the gun. As the gun fires, the rounds remaining display will count down as rounds are expended. If the gun will not fire with the trigger in the first detent, pull the trigger to the second detent. This will override any performance inhibitors but will not override a

safety inhibitor. The gun will fire until one of the following occurs:

- Ammunition supply is depleted.
- Burst limit is reached.
- Trigger is released.
- Gun fails.

(7) Cyclic WAS—deselect G or ORT LHG WAS—deselect GUN. When the desired quantity is expended or the target neutralized, deselect the gun. One of the following messages will be displayed to the CPG in the weapon status section of the HAD:

- GUN FAIL—the gun system has been detected as NO-GO.
- SIGHT?—the CPG's SIGHT SEL switch is in the STBY position.
- LIMITS—the gun system has reached an azimuth or elevation limit.
- RNDS####—the gun system is operational, and the number of rounds remaining will be displayed in the "####" spaces.

d. To operate the AWS in the *fixed mode* (CPG only), proceed as follows:

(1) CPG ARM—ARM. Position the CPG ARM switch to ARM.

(2) GUN select—FXD. The gun will remain in the STOW position (+11 degrees elevation).

(3) Cyclic WAS—G or ORT LHG WAS—GUN. Select the gun system by either momentarily positioning the cyclic WAS to G or by positioning the ORT LHG WAS to GUN. The message "CGUN" will be displayed to the pilot in the HAD. The gun will move from the STOW position to +0 degree elevation and azimuth.

(4) Acquire the target. The cued LOS reticle indicates the computed rounds impact point. It will appear when the CPG's LOS is within 20 degrees of the armament datum line. Maneuver the helicopter until the cued LOS reticle is on the target.

(5) Provide range to target. Provide the FCC with range data (laser, manual, autoranging, or TGT/NAV).

(6) WEAPONS trigger—press. Ensure the range information and weapon control/status in the HAD are appropriate for the desired engagement before firing. Lift the protective cover over the cyclic trigger switch or the ORT LHG trigger switch, and pull the trigger to the first detent. If the helicopter is on the ground, the PLT/GND ORIDE switch must be in the ORIDE position to fire the gun. If the gun will not fire in the first detent, pull

the trigger to the second detent. This will override any performance inhibitors but will not override a safety inhibitor. As the gun fires, the rounds remaining display will count down as rounds are expended. The gun will fire until one of the following occurs:

- Ammunition supply is depleted.
- Burst limit is reached.
- Trigger is released.
- Gun fails.

(7) Cyclic WAS—deselect G or ORT LHG WAS—deselect GUN. When the desired quantity is expended or the target neutralized, deselect the gun. One of the following messages will be displayed to the CPG in the HAD:

- GUN FAIL—the gun system has been detected as NO-GO.
- SIGHT?—the CPG's SIGHT SEL switch is in the STBY position.
- RNDS####—The gun system is operational, and the number of rounds remaining will be displayed in the "####" spaces.

I-20. AERIAL ROCKET CONTROL SYSTEM FIRING PROCEDURES

a. Weapon firing will be conducted according to the operator's manual checklist. To operate the ARCS in the *normal mode* (pilot only, independent), proceed as follows:

(1) MASTER ARM—ARM. Position the MASTER ARM switch to ARM.

(2) RKT select—NORM. Position the RKT select switch to NORM.

(3) Cyclic WAS—R. Momentarily position the cyclic WAS to R. The message "PRKT" will be displayed to the CPG in the weapon control section of the HAD.

(4) ARCP RNG-KM—set range. Set the range manually or select autoranging.

(5) ARCP ZONE SEL—select (arm) zone. Position the ARCP ZONE SEL switch to the ARM zone.

(6) Align rocket steering cursor. Place the LOS reticle on the target. Maneuver the helicopter to bring the rocket steering cursor over the LOS reticle. The cursor is directional only (step on the cursor). One of the following messages will be displayed to the pilot in the HAD:

- CPG MSL—the CPG has activated the missile system, outprioritizing the pilot's rocket selection.

- **RKT FAIL**—the rocket system has been detected as NO-GO.
- **SIGHT?**—the pilot's SIGHT SEL switch is in the STBY position.
- **ZONE?**—the pilot has not selected a zone on his ARCP.
- **ROCKETS**—the rocket system is selected and operational.

(7) WEAPONS trigger—press. Ensure the range information and weapon control/status are appropriate before firing. Lift the protective cover over the cyclic trigger switch, and pull the trigger to the first detent.

(a) If the helicopter is airborne, the selected number of rockets will fire. If the trigger is released before the selected quantity is fired, the firing cycle stops and the system resets for the next salvo. A TOF message will replace the "ROCKETS" message and will decrement from computed TOF to zero. It will then be replaced by the "ROCKETS" message. If the helicopter is on the ground, the CPG's PLT/GND ORIDE switch must be in the ORIDE position to enable the rockets to be fired.

(b) The CPG's RKT switch must be in either the OFF or NORM position, and the airspeed must be less than 100 knots. If the CPG RKT switch is in GND STOW, the pylons will go to the ground STOW position (no articulation) and the message "RKT-G-S" will be displayed in the weapon status section of the HAD when the rocket system is activated. If airspeed is above 100 knots, the pylons will go to the flight STOW position (no articulation) and the message "RKT-F-S" will be displayed in the weapon status section of the HAD when the rocket system is activated.

(c) As rockets are fired, the QTY REM indicator on the ARCP will count down to indicate the rounds remaining. If the rockets will not fire with the trigger in the first detent, pull the trigger to the second detent. This will override any performance inhibitors but will not override a safety inhibitor. The rockets will be fired until one of the following occurs:

- Rocket inventory for the selected zone is depleted.
- Quantity selected is reached.
- Trigger is released.
- Rocket system fails.

(8) Cyclic WAS—deselect R. When the selected quantity has been fired or the target neutralized, deselect rockets.

b. To operate the ARCS in the *cooperative (precision) mode (pilot)*, proceed as follows:

(1) MASTER ARM—ARM. Position the MASTER ARM switch to ARM.

(2) RKT select—NORM. The pilot must have his RKT switch in the NORM position and must have activated the rocket system. He will align the aircraft in response to the rocket steering cursor and fire the rockets.

(3) Cyclic WAS—R. Position the cyclic WAS to R. The message "PRKT" will be displayed to the CPG in the weapon control section of the HAD.

(4) ARCP PEN-M, QTY, and ZONE SEL—set. Set the PEN-M, QTY, and ZONE SEL switches on the ARCP.

(5) Align rocket steering cursor. Maneuver the helicopter to align the steering cursor over the LOS reticle without regard to the LOS reticle line of sight. The fire control system is using the TADS LOS and TADS range information (preferably laser).

(6) WEAPONS trigger—press. Ensure the range information and weapon control/status are appropriate before firing. Lift the protective cover over the cyclic trigger switch, and pull the trigger to the first detent. If the rockets will not fire, pull the trigger to the second detent.

(7) Cyclic WAS—deselect R. When the selected quantity has been fired or the target neutralized, deselect rockets.

c. To operate the ARCS in the *cooperative (precision) mode (CPG)*, proceed as follows:

(1) CPG ARM—ARM. Position the CPG ARM switch to ARM.

(2) RKT select—NORM. In a cooperative engagement, the CPG must have his RKT switch in the NORM position and must have activated the rocket system. He will track the target using the TADS and provide the range to the target with the LRF/D. One of the following messages will be displayed to the pilot in the HAD:

- **CPG MSL**—the CPG has activated the missile system, outprioritizing the pilot's rocket selection.
- **RKT FAIL**—the rocket system has been detected as NO-GO.
- **SIGHT?**—the pilot's SIGHT SEL switch is in the STBY position.
- **ZONE?**—the pilot has not selected a zone on his ARCP.
- **ROCKETS**—the rocket system is selected and operational.

(3) ORT LHG WAS—RKT. Position the ORT LHG WAS to RKT. The message “CRKT” will be displayed to the pilot in the weapon control section of the HAD. One of the following messages will be displayed to the CPG in the weapon status section of the HAD:

- **PLT MSL**—the pilot has activated the missile system, outprioritizing the CPG’s rocket selection.
- **RKT FAIL**—the rocket system has been detected as NO-GO.
- **SIGHT?**—the CPG’s SIGHT SEL switch is in the STBY position.
- **ZONE?**—the pilot has not selected a zone on his ARCP.
- **ROCKETS**—the rocket system is selected and operational.

(4) Acquire and track target with TADS. Track the target using the TADS as the selected line of sight.

(5) Provide range to target. Enter the range to the target (manual, autoranging, or laser).

(6) WEAPONS trigger—press. Ensure the range information and weapon control/status are appropriate before firing. If the airspeed increases above 100 knots, the fire control system will position the pylon racks in the flight STOW position (+4 degrees elevation). If the rocket system is activated, the fire control system will display the message “RKT-F-S” in the weapon status section of the HAD and will replace the rocket steering cursor with the fixed-rocket steering cursor (open I-beam). The operation is the same as described above except the pilot must steer the helicopter in azimuth and pitch to align the vertical line open space of the fixed-rocket steering cursor and the LOS reticle on the target. The selected number of rockets will now fire.

(a) If the trigger is released before the selected quantity is fired, the firing cycle stops and the system resets for the next salvo. A TOF message will replace the “ROCKETS” message and will decrement from a computed TOF to zero. It will then be replaced by the “ROCKETS” message. If the helicopter is on the ground, the CPG’s PLT/GND ORIDE switch must be in the ORIDE position to enable the rockets to be fired.

(b) As rockets are fired, the QTY REM indicator on the ARCP will count down to indicate the rounds remaining. If the rockets will not fire with the trigger in the first detent, pull the trigger to the second detent. This will override any performance inhibitors but will not override a

safety inhibitor. Rockets will be fired until one of the following occurs:

- Rocket inventory for the selected zone is depleted.
- Quantity selected is reached.
- Trigger is released.
- Rocket system fails.

(7) ORT LHG WAS—deselect RKT. When the engagement is complete, deselect the rockets.

d. To operate the ARCS in the *normal mode* (CPG only, independent), proceed as follows:

(1) CPG ARM—ARM. Position the CPG ARM switch to ARM.

(2) RKT select—NORM. Position the RKT select switch to NORM.

(3) Cyclic WAS—R or ORT LHG WAS—RKT. Select the rocket system by either momentarily positioning the cyclic WAS to R or by positioning the ORT LHG WAS to RKT. The message “CRKT” will be displayed to the pilot in the weapon control section of the HAD. One of the following messages will be displayed to the CPG in the weapon status section of the HAD:

- **PLT MSL**—the pilot has activated the missile system, outprioritizing the CPG’s rocket selector.
- **RKT FAIL**—the rocket system has been detected as NO-GO.
- **SIGHT?**—the CPG’s SIGHT SEL switch is in the STBY position.
- **ZONE?**—the pilot has not selected a zone on his ARCP.
- **ROUNDS**—the rocket system is selected and operational.

(4) ARCP PEN-M, QTY, and ZONE SEL—set. Set the PEN-M, QTY, and ZONE SEL switches on the ARCP. Selections must be made by the pilot.

(5) Align rocket steering cursor. Place the LOS reticle on the target. Maneuver the helicopter to bring the rocket steering cursor over the LOS reticle. The cursor is directional only (step on the cursor).

(6) Provide range to target. Enter the range to the target (manual, autoranging, laser, or TGT/NAV).

(7) WEAPONS trigger—press. Ensure the range information and weapon control/status are appropriate before firing. Lift the protective cover over either the ORT LHG or cyclic trigger as

appropriate to the first detent. If the helicopter is airborne, the quantity selected on the pilot's ARCP will be fired. If the trigger is released before the selected quantity is fired, the firing cycle stops and the system resets for the next salvo. A TOF message will replace the "ROCKETS" message and will decrement from computed TOF to zero. It will then be replaced by the "ROCKETS" message. If the helicopter is on the ground, the CPG must place the PLT/GND switch in the ORIDE position to enable rockets to be fired.

(8) Cyclic WAS—deselect G or ORT LHG WAS—deselect RKT. When the selected quantity has been fired or the target neutralized, deselect rockets.

I-21. POINT TARGET WEAPON SYSTEM FIRING PROCEDURES

a. Weapon firing will be conducted according to the operator's manual checklist. To operate the PTWS in the *LOBL normal mode (CPG, autonomous)*, proceed as follows:

(1) LOAL switch—OFF. Position the LOAL switch to OFF. This places the missile system in the LOBL delivery mode.

(2) MSL mode —NORM. Select the NORM fire delivery mode using the MODE switch. STBY is not an operational delivery mode.

(3) UPR/LWR CHAN code —as desired. Select the UPR/LWR CHAN code as desired.

(4) UPR/LWR CHAN QTY—as desired. Select the UPR/LWR CHAN QTY as desired. If the CPG has a quantity of more than one selected on the QTY indexer for the designated priority missile channel, the message "FIRE . . . MISSILES" will be displayed. When the fire control system has calculated that the minimum launch separation time has elapsed, the message "FIRE . . . MISSILES" will be displayed for two seconds to inform the CPG that he can launch the next missile. The TOF display for the first missile will continue to count down to zero when not over-ridden by a higher priority message. If a second missile is launched (rapid fire engagement), the TOF will display the time of flight for the second missile (and subsequent missiles), counting down to zero.

(5) CHAN SEL—establish priority channel. Use the CHAN SEL switch to designate the priority missile channel. Verify that the laser code of the LRF/D is the same as the laser code of the designated priority missile channel and that the LST code is as required. Once a channel is designated as the priority channel, the RHE will select, spin up, and encode the quantity of missiles as set up on the fire control panel. The status of the

missiles will be displayed on the AND 4 x 4 sections as they are detected if the launcher ARM/SAFE switch is in the ARM position. If the switch is in the SAFE position, the "SAFE" message will override the missile status and inventory. WAS action is not required for the 4 x 4 display. If the pilot has selected the rocket system, the CPG's missile action will overprioritize the pilot's rocket selection; the message "CPG MSL" will then be displayed to the pilot in the weapon status section of the HAD. If the CPG did not designate a priority channel, the message "MSL SEL?" will be displayed.

(6) CPG ARM—ARM. Position the CPG ARM switch to ARM.

(7) ORT LHG WAS—MSL. Select the missile system by placing the ORT LHG WAS in the MSL position. The message "CMSL" will be displayed to the pilot in the weapon control section of the HAD.

(8) Acquire the target. Track the target using the TADS as the selected sight. The LOBL missile constraints box will be displayed to both crew members. The pilot will steer the helicopter toward the constraints box (directional). If both missile channels are tracking the laser energy of the proper code, the message "2 CHANLS . . . TRACKING" will be displayed in the weapon status section of both the HAD and the AND. If the priority missile channel is tracking laser energy of the proper code, the message "PRI CHAN . . . TRACKING" will be displayed in the weapon status section of both the HAD and the AND. If the alternate missile channel is tracking laser energy of the proper code, the message "ALT CHAN . . . TRACKING" will be displayed in the weapon status section of both the HAD and the AND. If no channels are tracking, the delivery mode (LOBL, DIR, LO, or HI) and the fire delivery mode (STBY, NORM, RIPL, or MANL) will be displayed in the weapon status section of both the HAD and the AND.

(9) LRF/D trigger—press. Designate the target. Range information will be entered into the FCC and displayed in the HAD. When the laser is being fired on the same code as the priority channel missiles, the seekers on that code will be commanded to look toward the TADS LOS. When the missile seekers lock on the laser spot, the message "PRI CHAN . . . TRACKING" will be displayed in the HAD and AND. The AND 4 x 4 sections will indicate missile tracking status ("R" changes to "T"). When the constraints box changes from dashed to solid lines, the helicopter is within launch constraints. Continue to designate until the missile impacts the target.

(10) WEAPONS trigger—press. Ensure the range information and weapon control/status in the HAD are appropriate before firing. Lift the

protective cover over the ORT LHG trigger switch, and pull the trigger to the first detent. If the missile launch status is GO, the message "MSL LNCH" ("SIM LNCH" with training missile) will be displayed for two seconds in the HAD and AND. The TOF display for the missile will count down to zero when not overridden by a higher priority message.

(a) If the missile launch sequence fails, the status and inventory section for that missile will show "M" over "A." This indicates that the launch sequence was initiated, but either the battery failed to activate or the pneumatics within the missile failed and no motor fire signal was initiated. If the missile umbilical separation occurs at or before the predicted time, the launch message will be replaced by a TOF message. This message shows TOF from launch until impact, initialized at computed TOF (in seconds), decrementing toward zero. At the same time, the missile status and inventory for that missile will blank.

(b) If the missile umbilical separation does not occur within the predicted time, the RHE will indicate that a hangfire condition exists. The message "HANGFIRE" will be displayed for six seconds in the weapon status section of both the HAD and the AND. A missile on the opposite side of the helicopter will be selected by the RHE as the next missile to be launched and coded (if not already coded) on the priority channel laser code. After six seconds, the RHE will reselect missiles for launch based on the preferred firing order.

(11) **ORT LHG WAS—deselect MSL.** When the engagement is complete, deselect the missile system. If the ORT LHG weapons action switch was used, return it to the center position. Missile symbology will blank, and the AND 4 x 4 sections will continue to show missile status and inventory. If the cyclic weapons action switch was used to select the missile system, reselect the missile system. The missile messages will blank. The AND 4 x 4 sections will still show missile status and inventory.

b. To operate the PTWS in the *LOBL normal mode (rapid fire, CPG, autonomous or remote)*, proceed as follows:

(1) **LOAL switch—OFF.** Position the LOAL switch to OFF. This places the missile system in the LOBL delivery mode.

(2) **MSL mode—NORM.** Select the NORM fire delivery mode using the mode switch. STBY is not an operational delivery mode. If the pilot has selected the rocket system, the CPG's missile action will outprioritize the pilot's rocket selection and the message "CPG MSL" will be displayed to the pilot in place of the "ROCKETS" message in the weapon status section of the HAD.

(3) **UPR/LWR CHAN code—as desired.** Select the UPR/LWR CHAN code as desired.

(4) **UPR/LWR CHAN QTY—as desired.** If the CPG has a quantity of more than one selected on the QTY indexer for the designated priority missile channel, the message "FIRE . . . MISSILES" will be displayed. When the fire control system has calculated that the minimum launch separation time has elapsed, the message "FIRE . . . MISSILES" will be displayed for two seconds to inform the CPG that he can now launch the next missile.

(5) **CHAN SEL—establish priority channel.** Use the CHAN SEL switch to designate the priority missile channel (for autonomous or remote engagement). If the CPG has not selected a priority missile channel, the message "MSL SEL?" will be displayed in the weapon status section of both the HAD and the AND. The enhancement display portion of the AND will indicate the laser code assigned to each channel and will show which one is the priority channel. The AND 4 x 4 sections will show which missiles are ready.

(6) **CPG ARM—ARM.** Position the CPG ARM switch to ARM.

(7) **ORT LHG WAS—MSL.** Select the missile system by placing the ORT LHG WAS in the MSL position. The message "CMSL" will be displayed to the pilot in the weapon control section of the HAD.

(8) **Acquire the target.** Track the target using the TADS as the selected sight or call for remote designation of the target. The LOBL missile constraints box will be displayed to both crew members. The pilot will steer the helicopter toward the constraints box (directional). If both missile channels are tracking the laser energy of the proper code, the message "2 CHANLS . . . TRACKING" will be displayed in the weapon status section of both the HAD and the AND. If no channels are tracking, the delivery mode (LOBL, DIR, LO, or HI) and the fire delivery mode (STBY, NORM, RIPL, or MANL) will be displayed in the weapon status section of both the HAD and the AND. In this case, the message will read "LOBLNORM."

(9) **LRF/D trigger—press.** For autonomous engagements, designate the target. Range information will be entered into the FCC and displayed in the HAD. For remote engagements, provide the range to the target (manual, auto-ranging, laser, or TGT/NAV). When the laser is being fired on the same code as the priority channel missiles, the seekers on that code will be commanded to look toward the TADS LOS. With the remote missile channel prioritized, these missiles will be in a stare mode until they detect and lock on the laser energy of the proper code.

When the missile seekers lock on the laser spot, the message "PRI CHAN . . . TRACKING" will be displayed in the HAD and AND. The AND 4 x 4 sections will indicate missile tracking status ("R" changes to "T"). When the constraints box changes from dashed to solid lines, the helicopter is within launch constraints.

(10) WEAPONS trigger—press (step one).

Ensure the range information and weapon control/status in the HAD are appropriate before firing. Lift the protective cover over the ORT LHG trigger switch, and pull the trigger to the first detent. If the missile launch status is GO, the message "MSL LNCH" ("SIM LNCH" with training missile) will be displayed for two seconds in the HAD and AND. The TOF display for the missile will count down to zero when not overridden by a higher priority message.

(11) WEAPONS trigger—press (step two).

When the fire control system has calculated that the minimum launch separation time has elapsed, the message "FIRE . . . MISSILES" will be displayed for two seconds to inform the CPG that he can launch the next missile. To fire the next missile, pull the trigger to the first detent. If the second missile launch status is GO, the message "MSL LNCH" will be displayed again in the HAD and AND. The TOF for the first missile will count down until the computed minimum lase time for terminal guidance is reached. The message "LASE 1 . . . TARGET" will now be displayed until the TOF counter for the first missile reaches zero. The TOF for the second missile will then be displayed.

(12) WEAPONS trigger—press (step three).

When the separation time has elapsed, pull the trigger to the first detent. After the message "MSL LNCH" is displayed, the TOF for the second missile will count down until the computed minimum lase time for terminal guidance is reached. The message "LASE 2 . . . TARGET" will now be displayed until the TOF counter for the second missile reaches zero. The TOF for the third missile will then be displayed, followed by the message "LASE 3 . . . TARGET."

(a) If the missile launch sequence fails, the status and inventory section for that missile will show "M" over "A." This indicates that the launch sequence was initiated, but either the battery failed to activate or the pneumatics within the missile failed and no motor fire signal was initiated. If the umbilical separation occurs at or before the predicted time, the launch message will be replaced by a TOF message. This message shows TOF from launch until impact, initialized at computed TOF (in seconds), decrementing toward zero. At the same time, the missile status and inventory for that missile will blank.

(b) If the missile umbilical separation does not occur within the predicted time, the RHE will indicate that a hangfire condition exists. The message "HANGFIRE" will be displayed for six seconds in the weapon status section of both the HAD and the AND. A missile on the opposite side of the helicopter will be selected by the RHE as the next missile to be launched and coded (if not already coded) on the priority channel laser code. After six seconds, the RHE will reselect missiles for launch based on the preferred firing order.

NOTE: The lase target messages will prompt the CPG to either designate the target or call for the remote designator to lase the target.

(13) ORT LHG WAS—deselect WAS. When the engagement is complete, deselect the missile system. If the ORT LHG weapons action switch was used, return it to the center position. Missile messages will blank, and the AND 4 x 4 sections will continue to show missile status and inventory. If the cyclic weapons action switch was used to select the missile system, reselect the missile system. The missile messages will blank. The AND 4 x 4 sections will still show missile status and inventory.

c. To operate the PTWS in the *LOBL ripple mode* (CPG, autonomous and remote), proceed as follows:

(1) LOAL switch—OFF. Position the LOAL switch to OFF. This places the missile system in the LOBL delivery mode.

(2) MSL mode—RIPL. Select the RIPL fire delivery mode to enable the RHE to automatically reprioritize missile channels as required.

(3) UPR/LWR CHAN code—as desired. Select UPR/LWR CHAN code as desired.

(4) UPR/LWR CHAN QTY—as desired. Select UPR/LWR CHAN QTY as desired.

(5) CHAN SEL—establish priority channel. Use the CHAN SEL switch to designate the priority missile channel (remote missile is to be fired first). Verify that the LRF/D laser code is the same as the channel code of the missile to be fired autonomously and that the LST code is as required. Once a channel is designated as the priority channel, the RHE will select, spin up, and encode the quantity of missiles as set up on the fire control panel. The status of the missiles will be displayed in the AND 4 x 4 sections as they are detected if the launcher ARM/SAFE switch is in the ARM position. If the switch is in the SAFE position, the "SAFE" message will override the missile status and inventory. WAS action is not required for the 4 x 4 display. If the pilot has selected the rocket system, the CPG's missile action will overprioritize the pilot's rocket selection; the message "CPG

MSL" will then be displayed in place of the "ROCKETS" message in the weapon status section of the HAD. If the CPG did not designate a priority channel, the message "MSL SEL?" will be displayed in the weapon status section of both the HAD and the AND.

(6) CPG ARM—ARM. Position the CPG ARM switch to ARM.

(7) ORT LHG WAS—MSL. Select the missile system by placing the ORT LHG WAS in the MSL position. The message "CMSL" will be displayed to the pilot in the weapon control section of the HAD.

(8) Acquire the target. Track the autonomous target using the TADS as the selected sight, and call for designation of the remote target. If both missile channels are tracking laser energy of the proper code, the message "2 CHANLS . . . TRACKING" will be displayed in the weapon status section of both the HAD and the AND. If no channels are tracking, the delivery mode (LOBL, DIR, LO, or HI) and the fire delivery mode (STBY, NORM, RIPL, or MANL) will be displayed in the weapon status section of both the HAD and the AND. In this case, the message is "LOBLRIPL." The LOBL missile constraints box will be displayed to both crew members. The pilot will steer the helicopter toward the constraints box (directional).

(9) LRF/D trigger—press. Designate the target. Range information will be entered in the FCC and displayed in the HAD. With the remote missile channel prioritized, these missiles will be in a stare mode until they detect and lock on the laser energy of the proper code. When the missile seekers lock on the laser spot, the appropriate messages will be displayed in the HAD and the AND. The AND 4 x 4 sections will indicate missile tracking status ("R" changes to "T"). When the constraints box changes from dashed to solid lines, the helicopter is within launch constraints.

(10) WEAPONS trigger—press (step one). Ensure the range information and weapon control/status in the HAD are appropriate before firing. Lift the protective cover over the ORT LHG trigger switch, and pull the trigger to the first detent. If the missile launch status is GO, the message "MSL LNCH" ("SIM LNCH" with training missile) will be displayed for two seconds in the sight status section of both the HAD and the AND. The TOF display for the missile will count down to zero. After the missile is launched, the RHE will automatically designate the nonpriority channel as the priority channel for the next missile launch. The AND enhancement display will show this change.

(11) WEAPONS trigger—press (step two). To launch a missile for autonomous designation,

pull the trigger to the first detent. If the missile launch status is GO, the appropriate launch message will be displayed in the weapon status section of both the HAD and the AND. Now, two TOF messages are displayed. The RHE automatically prioritizes the remote channel once again. When minimum launch separation time for the first missile has elapsed, the message "FIRE . . . MISSILES" will replace the TOF message for two seconds to inform the CPG that he can launch the second missile on this laser code. This cycle will repeat for the autonomous missile code as well.

(12) WEAPONS trigger—press (step three). To launch a second missile for remote designation, pull the trigger to the first detent. If the missile launch status is GO, the appropriate launch message will again be displayed in the sight status section of both the HAD and the AND.

(a) When the computed minimum lase time for terminal guidance of each missile is reached, the TOF messages will be replaced by the lase target messages until the TOF counter for each missile reaches zero. If the missile launch sequence fails, the status and inventory section for that missile will show "M" over "A." This indicates that the launch sequence was initiated, but either the battery failed to activate or the pneumatics within the missile failed and no motor fire signal was initiated.

(b) If the missile umbilical separation occurs at or before the predicted time, the launch message will be replaced by the TOF message. This message shows TOF from launch until impact, initialized at computed TOF (in seconds), decrementing toward zero. If the missile umbilical separation does not occur within the predicted time, the RHE will indicate a hangfire condition.

(c) To launch the next missile, pull the weapons trigger to the first detent. The launch/fail sequence is the same as above, except this missile will have the other selected laser code. Now, two TOF messages are displayed—one in the weapon status section for the missile that has the same laser code as the LRF/D (autonomous) and the other in the sight status section for the missile that has a code different from the LRF/D (remote).

NOTE: The lase target messages will prompt the CPG to either designate the target or call for the remote designator to lase the target.

(13) ORT LHG WAS—deselect MSL. When the engagement is complete, deselect the missile system. If the ORT LHG weapons action switch was used to select, return it to the center position. Missile messages will blank, and the AND 4 x 4 sections will continue to show missile status and inventory. If the cyclic weapons action switch was

used to select the missile system, reselect the missile system. The missile messages will blank, and the AND 4 x 4 sections will still show missile status and inventory.

d. To operate the PTWS in the *LOBL normal mode (rapid fire, pilot, remote)*, proceed as follows:

(1) LOAL switch—OFF. Position the LOAL switch to OFF. This places the missile system in the LOBL delivery mode.

(2) LSR code switch—UPR/LWR. Momentarily position the switch to either UPR or LWR to designate the respective missile channel as set up on the CPG's fire control panel as the priority channel. If the pilot has not selected a priority missile channel, the message "MSL SEL?" will be displayed in the weapon status section of the HAD. If both missile channels are tracking laser energy of the proper code, the message "2 CHANLS . . . TRACKING" will be displayed in the weapon status section of the HAD. If no channels are tracking, the delivery mode (LOBL, DIR, LO, or HI) and the fire delivery mode (NORM) will be displayed in the weapon status section of the HAD.

(3) MASTER ARM—ARM. Position the MASTER ARM switch to the ARM position.

(4) Cyclic WAS—M. Momentarily position the cyclic WAS to the missile position. The message "PMSL" will be displayed to the CPG in the weapon control section of the HAD. The RHE will ignore the CPG's MODE switch position and set the system mode to normal fire delivery. Upper and lower channel codes will be displayed to the pilot in the sight status section of the HAD. The designated priority channel code will flash at a 1-hertz rate.

(5) Acquire the target. The pilot aligns the helicopter toward the target and calls for remote designation of the target. The LOBL constraints box will be displayed to both crew members. The seekers, which are in a scan mode, will lock on the laser spot and track the spot within their gimbal limits. When seekers are locked on and other constraints are met, the dashed box goes solid, indicating the pilot may launch a missile.

(6) Provide range to target. Enter the range using the ARCP (autoranging or manual).

(7) WEAPONS trigger—press (step one). Ensure the range information and weapon control/status in the HAD are appropriate before firing. Lift the protective cover over the cyclic trigger, and pull the trigger to the first detent. If the missile launch status is a GO, the message "MSL LNCH" ("SIM LNCH" with training missile) will be displayed for two seconds in the HAD. The TOF display for the missile will count

down to zero when not overridden by a higher priority message. If the missile umbilical separation occurs at or before the predicted time, the launch message will be replaced by a TOF message. This message shows TOF from launch until impact, initialized at computed TOF (in seconds), decrementing toward zero. If the missile umbilical separation does not occur by the predicted time, the RHE will indicate that a hangfire condition exists.

(8) WEAPONS trigger—press (step two). When the fire control system has calculated that the minimum launch separation has elapsed, the message "FIRE . . . MISSILES" will be displayed for two seconds to inform the pilot that he can launch the next missile. Again, pull the cyclic weapons trigger to the first detent. The TOF for the first missile will count down until the computed minimum lase time for terminal guidance is reached. Then the message "LASE 1 . . . TARGET" will be displayed until the TOF counter for the first missile reaches zero. The lase target messages prompt the the pilot to call for the remote designator to lase the target. The message "FIRE . . . MISSILES" will again be displayed to inform the pilot that he can launch the third missile. This launch cycle can be repeated until targets are destroyed or all missiles are expended.

(9) Cyclic WAS—deselect M. When the engagement is complete, deselect the missile system. Momentarily reselect the missile system using the cyclic WAS. The missile message will blank. Then momentarily select another weapon system using the cyclic WAS. Appropriate symbology will be displayed.

e. To operate the PTWS in the *LOAL mode (CPG, autonomous or remote)*, proceed as follows:

(1) LOAL switch—DIR, LO, or HI. Position the LOAL switch to DIR, LO, or HI. This places the missile system in the LOAL delivery mode.

(2) MSL mode—NORM. Select the NORM fire delivery mode using the MODE switch. STBY is not an operational delivery mode.

(3) UPR/LWR CHAN code—as desired. Select the UPR/LWR CHAN code as desired.

(4) UPR/LWR CHAN QTY—as desired. Select the UPR/LWR CHAN QTY as desired. If the CPG has a quantity of more than one selected on the QTY indexer for the designated priority missile channel, the message "FIRE . . . MISSILES" will be displayed. When the fire control system has calculated that the minimum launch separation time has elapsed, the message "FIRE . . . MISSILES" will be displayed for two seconds to inform the CPG that he can launch the next missile.

(5) CHAN SEL—establish priority channel. Use the CHAN SEL switch to designate the priority channel. Verify that the LRF/D laser code is set as required for autonomous or remote designation and that the LST code is as required. The enhancement display section of the AND will show the laser code assigned to each channel and indicate which one is the priority channel. The AND 4 x 4 sections will show which missiles are ready and next to be launched. Once a channel is designated as the priority channel, the RHE will select, spin up, and encode the quantity of missiles as set up on the fire control panel. The status of the missiles will be displayed on the AND 4 x 4 sections as they are detected if the launcher ARM/SAFE switch is in the ARM position. If the switch is in the SAFE position, the "SAFE" message will override the missile status and inventory. WAS action is not required for the 4 x 4 display.

(6) CPG ARM—ARM. Position the CPG ARM switch to ARM.

(7) ORT LHG WAS—MSL. Select the missile system by placing the ORT LHG WAS in the MSL position. The message "CMSL" will be displayed to the pilot in the weapon control section of the HAD. If the pilot has selected the rocket system, the CPG's missile action will overprioritize the pilot's rocket selection and the message "CPG MSL" will be displayed in place of the "ROCKETS" message in the weapon status section of the HAD. If the CPG did not designate a priority channel, the message "MSL SEL?" will be displayed in the weapon status section of both the HAD and the AND.

(8) Acquire the target. The target may or may not be visible. In the LOAL-DIR mode, the TADS is the active LOS for launch. The CPG may visually track the target or slave the TADS to the target location, ACQ SEL-TGT/NAV. The LOAL-LO or LOAL-HI mode will require the use of the TGT/NAV indexer to provide the active LOS for launch. The LOAL missile constraints box will be displayed to both crew members. The pilot will steer the helicopter towards the constraints box (directional). When the box changes from dashed to solid lines, the helicopter is within launch constraints. If the fire control system does not know the location of the target, the constraints box will not go solid. To launch the LOAL missile in this mode, the second trigger detent is used.

(9) Provide range to target. Provide the FCC with range data (laser, manual, autoranging, or TGT/NAV) to ensure accurate TOF messages.

(10) WEAPONS trigger—press. Ensure the range information and weapon control/status in the HAD are appropriate before missile firing. If the missile launch status is GO, the message "MSL

LNCH" ("SIM LNCH" with training missile) will be displayed for two seconds in the HAD and AND. The TOF display for the missile will count down to zero when not overridden by a higher priority message.

(a) If the missile launch sequence fails, the status and inventory section for that missile will show "M" over "A." This indicates that the launch sequence was initiated, but either the battery failed to activate or the pneumatics within the missile failed and no motor fire signal was initiated.

(b) If the missile umbilical separation does not occur within the predicted time, the RHE will indicate that a hangfire condition exists. A missile on the opposite side of the helicopter will be selected by the RHE as the next missile to be launched and coded (if not already coded) on the priority channel laser mode. After six seconds, the RHE will reselect missiles for launch based on the preferred firing order.

(11) Target designation. Designate the target at the proper time or call for remote designation.

(12) ORT LHG WAS—deselect MSL. When the engagement is complete, deselect the missile system. If the TADS ORT LHG weapons action switch was used to select the missile system, return it to the center position. Missile messages will blank, and the AND 4 x 4 sections will continue to show missile status and inventory. If the cyclic weapons action switch was used to select the missile system, reselect the missile system. The missile messages will blank, and the AND 4 x 4 sections will still show missile status and inventory.

f. To operate the PTWS in the LOAL ripple mode (CPG, autonomous and remote), proceed as follows:

(1) LOAL switch—DIR, LO, or HI. Position the LOAL switch to DIR, LO, or HI. This places the missile system in the LOAL delivery mode.

(2) MSL mode—NORM. Select the NORM fire delivery mode using the MODE switch. STBY is not an operational delivery mode. If the pilot has selected the rocket system, the CPG's missile action will overprioritize the pilot's rocket selection and the message "CPG MSL" will be displayed to the pilot in place of the "ROCKETS" message in the weapon status section of the HAD. If the CPG did not designate a priority channel, the message "MSL SEL?" will be displayed in the weapon status section of both the HAD and the AND.

(3) UPR/LWR CHAN code—as desired. Select the UPR/LWR CHAN code as desired.

(4) UPR/LWR CHAN QTY—as desired. Select the UPR/LWR CHAN QTY as desired.

(5) CHAN SEL—establish priority channel. Use the CHAN SEL switch to designate the priority channel. The remote missile will be fired first. Verify that the LRF/D laser code is set as required for autonomous or remote designation and the LST code is as required. Once a channel is designated as the priority channel, the RHE will select, spin up, and encode the quantity of missiles as set up on the fire control panel. The status of the missiles will be displayed in the AND 4 x 4 sections as they are detected if the launcher ARM/SAFE switch is in the ARM position. If the switch is in the SAFE position, the "SAFE" message will override the missile status and inventory. WAS action is not required for the 4 x 4 display. The enhancement display portion of the AND will indicate the laser code assigned to each channel and which one is the priority channel. The AND 4 x 4 sections will show which missiles are ready and the next to be launched.

(6) CPG ARM—ARM. Position the CPG ARM switch to ARM.

(7) ORT LHG WAS—MSL. Select the missile system by placing the ORT LHG WAS in the MSL position. The message "CMSL" will be displayed to the pilot in the weapon control section of the HAD.

(8) Acquire the target. The target may or may not be visible. In the LOAL-DIR mode, the TADS is the active LOS for launch. The CPG may visually track the target or slave the TADS to the target location, ACQ SEL-TGT/NAV. The LOAL-LO or LOAL-HI mode will require the use of the TGT/NAV indexer to provide the active LOS for launch. If no channels are tracking, the delivery mode (LOBL, DIR, LO, or HI) and the fire delivery mode (STBY, NORM, RIPL, or MANL) will be displayed in the weapon status section of both the HAD and the AND. In this case, the message is DIR RIPL, LO RIPL, or HI RIPL, as selected. The LOAL missile constraints box will be displayed to both crew members. The pilot will steer the helicopter towards the constraints box (directional). When the box changes from dashed to solid lines, the helicopter is within launch constraints.

(9) Provide range to target. Provide the FCC with range data (laser, manual, autoranging, or TGT/NAV) to ensure accurate TOF messages.

(10) WEAPONS trigger—press (step one). Ensure the range information and weapon control/status in the HAD are appropriate before firing. If the missile launch status is GO, the message "MSL LNCH" ("SIM LNCH" with training missile) will be displayed for two seconds in the HAD and AND. The TOF display for the missile will count down to zero when not overridden by a higher priority message. After the missile is launched, the RHE will automatically

designate the nonpriority channel as the priority channel for the next missile launch. The AND enhancement display will show this change. If the missile launch sequence fails, the status and inventory section for that missile will show "M" over "A." This indicates that the launch sequence was initiated, but either the battery failed to activate or the pneumatics within the missile failed and no motor fire signal was initiated.

(11) WEAPONS trigger—press (step two). To launch a missile for autonomous designation, pull the trigger to the first detent. If the missile launch status is GO, the appropriate launch message will be displayed in the weapon status section of both the HAD and the AND. Now, two TOF messages are displayed. The RHE automatically prioritizes the remote channel once again. When minimum launch separation time for the first missile has elapsed, the message "FIRE . . . MISSILES" will replace the TOF message for two seconds to inform the CPG that he can launch the second missile on this laser code. This cycle will repeat for the autonomous missile code as well. If the missile umbilical separation does not occur within the predicted time, the RHE will indicate a hangfire condition.

(12) WEAPONS trigger—press (step three). To launch a second missile for remote designation, pull the trigger to the first detent. If the missile launch status is GO, the appropriate launch message will again be displayed in the sight status section of both the HAD and the AND. When the computed minimum lase time for terminal guidance of each missile is reached, the TOF messages will be replaced by the lase target message until the TOF counter for each missile reaches zero.

NOTE: The lase target messages will prompt the CPG to either designate the target or call for the remote designator to lase the target.

(13) ORT LHG WAS—deselect MSL. When the engagement is complete, deselect the missile system. If the ORT LHG weapons action switch was used to select the missile system, return it to the center position. Missile messages will blank, and the AND 4 x 4 sections will continue to show missile status and inventory. If the cyclic weapons action switch was used to select the missile system, reselect the missile system. The missile messages will blank, and the AND 4 x 4 sections will still show missile status and inventory.

g. To operate the PTWS in the LOAL mode (pilot, remote), proceed as follows:

(1) LOAL switch—DIR, LO, or HI. Position the LOAL switch to DIR, LO, or HI. This places the missile system in the LOAL delivery mode.

(2) LSR code switch—UPR/LWR.

Momentarily position the switch to either position to designate the respective missile channel as set up on the CPG's fire control panel as the priority channel.

(3) MASTER ARM—ARM. Position the MASTER ARM switch to ARM.

(4) Cyclic WAS—M. Momentarily position the cyclic WAS to the missile position. The message "PMSL" will be displayed to the CPG in the weapon control section of the HAD. The RHE will ignore the CPG's mode switch position and set the system mode to the normal fire delivery mode. Upper and lower channel codes will be displayed to the pilot in the sight status section of the HAD. The designated priority channel code will flash at a 1-hertz rate.

(5) Acquire the target. The target may or may not be visible. In the LOAL mode (from the pilot's station), the IHADSS is the active LOS for launch. The LOAL missile constraints box will be displayed to both crew members. The pilot orients his IHADSS toward the target and steers the helicopter to bring it into launch constraints. When constraints are met, the box will change from dashed to solid lines. If the pilot has not provided the fire control system a means of locating the target (LOS + range), the constraints box will not go solid. To launch an LOAL missile in this mode, the second trigger detent will be used.

(6) Provide range to target. Enter range using the ARCP (autorangeing or manual).

(7) WEAPONS trigger—press (step one). Ensure the range information and weapon control/status in the HAD are appropriate before firing. Lift the protective cover over the cyclic trigger, and pull the trigger to the first detent. If the missile launch status is a GO, the message "MSL LNCH" ("SIM LNCH" with training missile) will be displayed for two seconds in the HAD. The TOF display for the missile will count down to zero when not overridden by a higher priority message.

(8) WEAPONS trigger—press (step two). When the fire control system has calculated that the minimum launch separation has elapsed, the message "FIRE . . . MISSILES" will be displayed for two seconds to inform the pilot that he can launch the next missile. Again, pull the cyclic weapons trigger to the first detent. If the second missile launch status is GO, the message "MSL LNCH" will be displayed for two seconds in the HAD and then the message will be replaced by a missile TOF message. The TOF for the first missile will count down until the computed minimum lase time for terminal guidance is reached; then the message "LASE 1 . . . TARGET" will be displayed

until the TOF counter for the first missile reaches zero. The lase target messages prompt the pilot to call for the remote designator to lase the target. The message "FIRE . . . MISSILES" will again be displayed to inform the pilot that he can launch the third missile. This launch cycle can be repeated until targets are destroyed or all missiles are expended.

(9) Cyclic WAS—deselect M. When the engagement is complete, deselect the missile system. Momentarily reselect the missile system using the cyclic WAS. The missile messages will blank.

I-22. SIMULTANEOUS FIRING OF WEAPONS

No significant problems exist with the simultaneous firing of weapons. Built-in safety inhibitors preclude weapon interference while firing. The appropriate division of crew duties is the major consideration when firing certain combinations of weapons. The AH-64 is capable of the following simultaneous weapon firing combinations:

a. PILOT-GUN and CPG-MISSILE. The pilot must maintain the aircraft within the launch and postlaunch constraints for missile firing while using the gun.

b. PILOT-GUN and CPG-ROCKETS. This is not the usual combination since the CPG must fly the aircraft to align rocket steering symbology. The pilot must set the zone, quantity, and range.

c. PILOT-ROCKET and CPG-GUN. The pilot fires the rocket using the independent mode, and the CPG fires the gun using the IHADSS or TADS.

d. PILOT-ROCKET and CPG-MISSILE. The pilot must use the independent mode and fly the aircraft into constraints for both the missile and rockets. This method is easier if both crew members are firing at the same target. The rocket solution is not presented until the missile leaves the aircraft.

e. PILOT-MISSILE and CPG-GUN. The pilot is limited to remote designator launches, and the CPG must set both the missile code and quantity. The CPG fires the gun using the IHADSS or TADS.

f. PILOT-MISSILE and CPG-ROCKETS. This can be done, but it is an inappropriate division of duties. The CPG must fly the aircraft into constraints for both the missile and rockets, setting both the missile code and quantity. The pilot must set the zone, quantity, and range for rockets. Meeting weapon system constraints for simultaneous rocket and missile fire is easier if

both crew members are firing at the same target array. The rocket solution is not presented until the missile leaves the aircraft.

*NOTE: Simultaneous weapons firing **cannot** be done when rockets are fired in the cooperative mode, since both crew members must set the WAS to rockets.*

Section IV

DEGRADED SYSTEM OPERATIONS AND INHIBITORS

I-23. DEGRADED SYSTEM OPERATIONS

The degraded system operations that result from a system or single component failure are listed in Table I-2.

I-24. INHIBITORS

The safety and performance inhibitors that are incorporated into the AH-64 weapon system are detailed in Table I-3.

Table I-2. Degraded system operations

FAILURE	RESULTS		
1. SYMBOL GENERATOR	TADS and PNVS revert to FLIR II operation with no symbology. TADS has only TADS LOS and IAT gates.	8. IHADSS-INVALID LOS	The last valid LOS direction will be maintained. Check helmet in motion box and clear obstructions to SSUs. If invalid LOS is not corrected, status will revert to IHADSS FAIL.
2. PNVS	Complete loss of PNVS: must accomplish emergency takeover of TADS or exit NOE environment.	9. IHADSS FAIL	The LOS reverts to fixed forward. Check helmet connection and IHADSS CB. If failure not corrected, check FD/LS.
3. ACM	Crew member must set FLIR gain and level manually.	10. PILOT FIRE CONTROL PANEL	The pilot may not activate weapons, select sights, perform acquisition or video functions, or adjust FLIR or HDU display.
4. TADS	TADS cannot be used as an LOS. The LOS reverts to fixed forward. TADS failure occurs when the TEU, power supply, or servo malfunctions. TADS may be manipulated, depending on the nature of the failure. Determine failure mode by consulting FD/LS. If TEU failed, PNVS will automatically go to DIRECT mode and azimuth limits will decrease to ± 75 degrees.	11. RADAR ALTIMETER	Radar altitude displays and automatic range capability are lost.
5. ALPHANUMERIC DISPLAY	AND is blank. Select SP1 on DEK, and input right shift 3. The AND-type display will be available on selected CRT.	12. AIR DATA SENSOR	DASE scheduling is lost, but hover gains are retained; atmospheric data for fire control solutions are lost. The symbolic true airspeed becomes the ground speed from the Doppler. The CB and the switch should be checked. AUTO STAB capability is also lost.
6. GUN OUT-OF-COINCIDENCE	The gun will maintain the last valid azimuth command and will move to elevation stow. To regain control of the gun, place the WAS to the OFF position and then to the GUN position.	13. FLASHING LOS RETICLE	Caused by an invalid LOS of the selected sight, an inoperative weapon activating, the selected sight failing, or the selected sight reaching its limits.
7. ROCKETS FAIL TO INVENTORY	Complete loss of rocket system: attempt to inventory by cycling rocket ELEC CB or ARM/SAFE power.	14. HARS	DASE, inertial reference for fire control solutions, way point and targeting, and symbolic trim ball are lost. The velocity vector and acceleration cue become Doppler driven. RAI, RMI, HSI, and heading symbology become inoperative. The HARS FD/LS should be checked.

Table 1-2. Degraded system operations (continued)

15. DOPPLER (MALF LT)	Navigation capability, HARS damping, and way point and targeting are lost. The symbolic vertical speed will lag the aircraft.	19. HELLFIRE ELECTRONICS	Missile caution light is illuminated. Missile FD/LS should be initiated. Missile cannot be fired.
16. DOPPLER (MEM LT)	The aircraft position will be in error if rates change while in memory. HARS will drift. Position update should be performed when Doppler is out of memory.	20. MISSILES	T F in AND: an orderly shutdown of the missile system in both cockpits. The CPG can only turn on the missile system to check the BIT.
17. DATA ENTRY KEYBOARD	Data cannot be entered or changed in the FCC.		N A in AND: an orderly shutdown of the missile system in both cockpits. The CPG can only turn on the missile system to check the BIT.
18. CPG FIRE CONTROL PANEL	The CPG cannot activate, select, or fire weapons; cannot select sight or acquisition functions; cannot select missile codes or quantity; and cannot select way-point locations. He may still use the ARM/SAFE, CCM, MUX ON/OFF, and PRI/SEC MUX switches.		The deice dome fails to fire on the first trigger. LOBL should be pulled. Missile must be fired LOAL. Pylons do not articulate. The aircraft must be pitched into constraints.

Table 1-3. Safety and performance inhibitors

SAFETY INHIBITORS	
GUN	
1. Gun firing is inhibited for two seconds after a rocket or a missile is launched.	8. Rockets are inhibited by a pylon error greater than 3.5 degrees with IHADSS LOS.
2. Gun azimuth is limited to 60 degrees when rockets are selected.	9. Rockets and missiles are inhibited when the gun is out of coincidence.
3. If the next missile to be fired is inboard, the gun azimuth is limited to 52 degrees when missiles are selected.	10. Rockets and missiles are inhibited when vertical acceleration exceeds +.5G.
4. Gun elevation drive is limited to -1.7 degrees on the ground.	MISSILE
5. Gun and LOS coincidence is greater than 6 degrees.	11. Missile is inhibited for pylon elevation less than -1.7 degrees.
ROCKETS	PERFORMANCE INHIBITORS
6. Rockets are inhibited for one second when a missile is launched.	1. Missile is inhibited during LOBL if not within prelaunch constraints.
7. Rockets are inhibited by a pylon error greater than 0.5 degree with TADS LOS.	2. Missile is inhibited if seeker error is greater than 2 degrees with TADS LOS while lasing a target.
	3. Missile is inhibited for excessive aircraft pitch, roll, yaw rates, and accelerations when roll angle is greater than 20 degrees.
	4. Missile is inhibited if the pylon servo error is greater than 5 degrees (LOAL mode only).

GLOSSARY

ACRONYMS AND ABBREVIATIONS

A	attack (panel design nomenclature)	CDU	computer display unit
AADS	airspeed and direction sensor	CEOI	Communications-Electronics Operation Instructions
AC	alternating current	CG	center of gravity
A/C	aircraft (panel design nomenclature)	CGUN	copilot gun (panel design nomenclature)
ACM	accumulator	CH	cargo helicopter
ACQ	acquire (panel design nomenclature)	CHAN	channel (panel design nomenclature)
ADA	air defense artillery	CHANLS	channels (panel design nomenclature)
ADS	air data subsystem	CMS	combat mission simulator
ADSS	air data sensor subsystem	CMSL	copilot actioned missile system (panel design nomenclature)
ADV	advance (panel design nomenclature)	co	company
AF	Air Force	COMP	compensation (panel design nomenclature)
AGES	air-ground engagement system	CONT	control (panel design nomenclature)
AGL	above ground level	CONVERG	convergence (panel design nomenclature)
AGST	gunnery skills test	coop	cooperative
AH	attack helicopter	CMSL	copilot missile (panel design nomenclature)
AHIP	Army helicopter improvement program	CPG	copilot/gunner
ALCA	aircraft loader control assembly	CRKT	copilot rocket (panel design nomenclature)
ALT	airborne laser tracker	CRT	cathode ray tube
AND	alphanumeric display	C/W	caution/warning
APU	auxiliary power unit	CWEPT	combat weapon and emergency procedures trainer
AQC	aviator qualification course		
AR	Army regulation	DA	Department of the Army
ARCP	aerial rocket control panel	DASE	digital automatic stabilization equipment
ARCS	aerial rocket control system	DC	direct current
ARMED	armed (panel design nomenclature)	DD	Department of Defense
ARTEP	Army Training and Evaluation Program	deg	degree
ATGM	antitank guided missile	DEK	data entry keyboard
ATM	aircrew training manual	DIR	direct (panel design nomenclature)
ATS	acquired-track-stow (panel design nomenclature)	div	division
ATTK	attack (panel design nomenclature)	DS	direct support
attn	attention	DTV	day television
AUTO	automatic (panel design nomenclature)	DVO	direct view optics
AWS	area weapon system		
az	azimuth	ECAS	enhanced Cobra armament system
BBC	backup bus controller	ECM	electronic countermeasures
BIT	built-in test	ei	elevation
BOT	burst on target	ELEC	electrical (panel design nomenclature)
BRSIT	boresight (panel design nomenclature)	EOD	explosive ordnance disposal
BRT	bright (panel design nomenclature)	EPS	electronic power supply
btry	battery	EPU	electronics processor unit
B/W	black on white (panel design nomenclature)	ETL	effective translational lift
CALFEX	combined arms live-fire exercise		
cav	cavalry	FAAO	forward area air observer
CB	circuit breaker	FAB	forward avionics bay
CCIP	continuously computed impact point		
CCM	counter-countermeasure		
CCRP	continuously computed release point		

FAIL	failure (panel design nomenclature)	inf	infantry
FARP	forward arming and refueling point	IP	instructor pilot
FCC	fire control computer	IR	infrared
FCP	fire control panel	IRIS	infrared imaging seeker
FCR	fire control reticle	JAAT	joint air attack team
FDC	fire direction center	km	kilometer
FD/LS	fault detection/location system	kt	knot
FFAR	folding fin aerial rocket	LAI	low airspeed indicator
FLIR	forward looking infrared	LAT	latitude (panel design nomenclature)
FLTR	filter (panel design nomenclature)	LEU	laser electronics unit
FM	field manual or frequency modulated	LH	left hand
FOC	focus (panel design nomenclature)	LHG	left hand grip
FOV	field of view	LMC	linear motion compensator
FP	firing point	LNCH	launch (panel design nomenclature)
ft	feet	LO	low (panel design nomenclature)
FWS	flight weapon simulator	LOAL	lock-on after launch
FXD	fixed (panel design nomenclature)	LOBL	lock-on before launch
GEN	generator (panel design nomenclature)	LOS	line of sight
GHS	gunner's helmet sight	LRF	laser range finder
G-M	grid to magnetic	LRF/D	laser range finder/designator
GND	ground (panel design nomenclature)	LRSNCO	laser range safety noncommissioned officer
GS	ground speed	LRSO	laser range safety officer
G/T	greater time	LRU	line replaceable unit
GTA	graphic training aid	LSR	laser (panel design nomenclature)
GZN	grid zone (panel design nomenclature)	LST	laser spot tracker
HAD	high action display (panel design nomenclature)	lt	light
HARS	heading and altitude reference system	LTU	laser transceiver unit
HDD	heads-down display	LWR	lower (panel design nomenclature)
HDM	Hellfire dummy missile	LZ	landing zone
HDU	helmet display unit	m	meter
HE	high explosive	MAG	magnification (panel design nomenclature)
HEAT	high-explosive antitank	MALF LT	malfunction light (panel design nomenclature)
HEDP	high-explosive, dual-purpose	MAN	manual (panel design nomenclature)
HI	high (panel design nomenclature)	MANL	manual (panel design nomenclature)
HMD	helmet mounted display	max	maximum
HOD	heads-out display	MC	modernized Cobra
HQ	headquarters	MED	medium (panel design nomenclature)
HSI	horizontal situation indicator	MEDEVAC	medical evacuation
HSS	helmet sight subsystem	MEM LT	memory light (panel design nomenclature)
HTF	how to fight	MFOV	medium field of view
HTM	Hellfire training missile	mg	machine gun
HUD	heads-up display	MILES	multiple integrated laser engagement system
Hz	hertz	mm	millimeter
IAT	image autotrack	MMS	mast mounted sight
IAW	In accordance with	MOD	modified
IGE	in-ground effect	MOUT	military operations on urbanized terrain
IHADSS	integrated helmet and display sight system	MPRC	multipurpose range complex
III	illumination	MPSM	multipurpose submunition
ILS	instrument landing system		
Indir	Indirect		

MRTU	multiplex remote terminal unit	QSTAG	Quadripartite Standardization Agreement
MSL	missile (panel design nomenclature)	QTY	quantity (panel design nomenclature)
MTOE	modified table(s) of organization and equipment	R	ready (panel design nomenclature)
MUX	multiplex	RAI	remote attitude indicator
MV	magnetic variation (panel design nomenclature)	RC	range control
NA	not applicable	RCD	recorder (panel design nomenclature)
NATO	North Atlantic Treaty Organization	RCO	range control officer
NAV	navigation (panel design nomenclature)	RCPU	rocket control panel unit
NBC	nuclear, biological, chemical	RDY	ready (panel design nomenclature)
NCO	noncommissioned officer	recon	reconnaissance
NCOIC	noncommissioned officer in charge	REM	remaining (panel design nomenclature)
NFOV	narrow field of view	RF	radar frequencing
NG	National Guard	RFD	range finder designator (panel design nomenclature)
no	number	RH	right hand
NOE	nap-of-the-earth	RHE	remote Hellfire electronics
NORM	normal (panel design nomenclature)	RHG	right hand grip
NVG	night vision goggles	RIPL	ripple (panel design nomenclature)
NVS	night vision system	rkt	rocket
OFS	offset (panel design nomenclature)	RMI	radio magnetic indicator
OGE	out-of-ground effect	RMS	rocket management subsystem
OH	observation helicopter	RND REM	rounds remaining (panel design nomenclature)
OIC	officer in charge	RNDS	rounds (panel design nomenclature)
op	operation	RNG	range (panel design nomenclature)
OPORD	operation order	RNG-KM	range-kilometers (panel design nomenclature)
OPSEC	operations security	RSO	range safety officer
ORIDE	override (panel design nomenclature)	SAM	send a message
ORT	optical relay tube	sec	second
OVRD	override (panel design nomenclature)	SEL	select (panel design nomenclature)
P	pilot	SEU	sight electronics unit
para	paragraph	SIGHT SEL	sight selection switch (panel design nomenclature)
PEN	penetrate (panel design nomenclature)	SIM	simulation (panel design nomenclature)
PEN-M	penetrate-manually (panel design nomenclature)	SIP	standardization instructor pilot
PGUN	pilot gun (panel design nomenclature)	SKR	seeker (panel design nomenclature)
PHS	pilot helmet sight	smk	smoke
PIC	pilot in command	SOP	standing operating procedure
plt	pilot	SP	special instructions
PLT/GNR	pilot to gunner	SPH	spheroid (panel design nomenclature)
PMSL	pilot missile	SSN	social security number
PNVS	pilot night vision sensor	SSU	sight survey units
POL	petroleum, oils, and lubricants	ST	store (panel design nomenclature)
PPOS	present position (panel design nomenclature)	STAB	stabilator (panel design nomenclature)
PRI	primary (panel design nomenclature)	STANAG	Standardization Agreement
PROD	production	STBY	standby (panel design nomenclature)
PRKT	pilot rocket (panel design nomenclature)	std	standard
PSI	pilot's steering indicator	STRAC	Standards In Training Commission
PTWS	point target weapon system	SYM	symbology (panel design nomenclature)
PWR ON	power on (panel design nomenclature)	sys	system
PZ	pickup zone	TADS	target acquisition and designator system
QE	quadrant elevation	TAL	training aircraft laser

TB	technical bulletin
TC	training circular
TCB	turret control box
TCP	TOW control panel
TEU	TADS electronic unit
tgt	target
TGT/NAV	target/navigation
TKR	tracker (panel design nomenclature)
TM	technical manual
TOE	table(s) of organization and equipment
TOF	time of flight
TOW	tube-launched, optically tracked, wire-guided missile
TRADOC	Training and Doctrine Command
TRGT	target (panel design nomenclature)
TRTG	tactical radar threat generator
TRK	track (panel design nomenclature)
TSEM	TOW system evaluation missile
TSGMS	test set guided missile system
TSOP	tactical standing operating procedure
TSR	TOW sight reticle
TSU	telescopic sight unit
TV	television

UH	utility helicopter
UPDT/ST	update/store (panel design nomenclature)
UPR	upper (panel design nomenclature)
US	United States (of America)
UT	unit trainer
UTM	universal transverse Mercator (grid)
UTS	universal turret subsystem
v	volt
VAC	volts, alternating current
VDC	volts, direct current
veh	vehicle
VID	video (panel design nomenclature)
W	wide
WAS	weapons action switch
W/B	white on black (panel design nomenclature)
WFOV	wide field of view
WRM	width, range, meters
Z	zoom
ZFOV	zoom field of view
ZSU	Soviet self-propelled antiaircraft gun

REFERENCES

Section I

REQUIRED PUBLICATIONS

Required publications are sources that users must read to understand or comply with this publication.

Army Regulations (ARs)

95-16	Weight and Balance: Army Aircraft
350-1	Army Training
385-62	Regulations for Firing Guided Missiles and Heavy Rockets for Training, Target Practice and Combat
385-63	Policies and Procedures for Firing Ammunition for Training, Target Practice and Combat
385-64	Ammunition Explosives Safety Standards

Field Manuals (FMs)

1-100	Combat Aviation Operations
1-111	Aviation Brigade
1-204	Night Flight Techniques and Procedures
1-301	Aeromedical Training for Flight Personnel
1-402	Aviator's Recognition Manual
17-35	Aeroscout Procedures
17-95 (HTF)	Cavalry (How to Fight)
21-11	First Aid for Soldiers
21-76	Survival, Evasion, and Escape
23-67	Machine Gun, 7.62-mm, M60
25-1	Training
44-30	Visual Aircraft Recognition
90-4 (HTF)	Airmobile Operations (How to Fight)
100-5 (HTF)	Operations (How to Fight)

Technical Manuals (TMs)

3-4240-280-10	Operator's Manual for Mask, Chemical-Biological: Aircraft, ABC-M24 and Accessories; Mask, Chemical-Biological, Tank, M25/M25A1 and Accessories
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9-1005-262-14	Operator, Organizational, Direct Support, and General Support Maintenance Manual for Armament Subsystem, Helicopter: 7.62-mm Machine Gun: Door Mounted, Lightweight, M23 (Used on UH-1D/UH-1H Helicopter), M24 (Used on CH-47 Series Helicopter), and M41 (Used on CH-47 Series Helicopter)
9-1300-200	Ammunition, General
9-1300-206	Ammunition and Explosives Standards
9-1340-222-20	Organizational Maintenance Manual (Including Repair Parts and Special Tools List): 2.75-Inch Low Spin, Folding Fin Aircraft Rockets: 66-mm, Light Antitank Weapon Systems; 3.75-Inch Rockets and M382E1 Rocket Motor (JATO)
9-1400-461-20	Organizational Maintenance Manual: Guided Missile Launcher Helicopter Armament Subsystem M22 (Used on UH-1B Helicopter)
9-1425-473-20	Organizational Maintenance Manual for Armament Subsystem, Helicopter TOW Guided Missile M65 (TOW Airborne System)
43-0001-27	Army Ammunition Data Sheets: Small Caliber Ammunition (FSC 1305)
55-405-9	Army Aviation Maintenance Engineering Manual: Weight and Balance
55-1520-220-10	Operator's Manual: Army Model UH-1C/M Helicopter
55-1520-221-10	Operator's Manual: Army Model AH-1G/TH-1G Helicopter
55-1520-234-10	Operator's Manual: Army Model AH-1S (MOD) Helicopter
55-1520-236-10	Operator's Manual, Army Model AH-1S (PROD), AH-1S (ECAS), AH-1S (Modernized Cobra) Helicopters
55-1520-238-10	Operator's Manual for Army Model AH-64A Helicopter

Section II

RELATED PUBLICATIONS

Related publications are sources of additional information. They are not required in order to understand this publication.

Army Training and Evaluation Programs (ARTEPs)

17-85	Combat Aviation Battalion
17-205	Air Cavalry Squadron
17-385	Attack Helicopter Battalion

Field Manuals (FMs)

1-101	Aircraft Battlefield Countermeasures and Survivability (ABCS)
1-102	Army Aviation in an NBC Environment
1-104	Forward Arming and Refueling Points
1-107	Air-to-Air Combat
1-112	Attack Helicopter Battalion
1-113	Assault Helicopter Battalion
1-114	Regimental Aviation Squadron
1-116	Air Cavalry Troop
1-203	Fundamentals of Flight
100-1	The Army
100-20	Low Intensity Conflict

Standardization Agreements (STANAGs)

2951 (QSTAG 769)	Non-Electronic Communications for Helicopters
3117 (Air Std 44/42)	Aircraft Marshalling Signals

Technical Bulletin (TB)

MED 501	Occupational and Environmental Health: Hearing Conservation
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Technical Manuals (TMs)

9-1005-257-12	Aviation Unit Maintenance Manual for Armament POD, Aircraft: 7.62-mm Machine Gun, M18A1 (Used on AH-1G Helicopter)
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9-1005-298-12	Aviation Unit Maintenance Manual: Armament Subsystem, Helicopter, 7.62-mm Machine Gun: High Rate, M27E1 (OH-6A Helicopter)
9-1005-299-12	Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 20-mm Automatic Gun: M35 (Used on AH-1G Helicopters)
9-1010-207-12	Aviation Unit Maintenance Manual: Armament Subsystem, Helicopter, 40-mm Grenade Launcher: M5 (Used on UH-1B or UH-1C Helicopters)
9-1055-460-13&P	Operator's Aviation Unit and Intermediate Maintenance Manual Including Repair Parts and Special Tools for Hydra 70 Rocket Launchers (Formerly 2.75-Inch Rocket Launchers)
9-1090-202-12	Aviation Unit Maintenance Manual: Armament Subsystem, Helicopter: 7.62-mm Machine Gun—2.75-Inch Rocket Launcher: M21 (Used on UH-1B and UH-1C Helicopters)
9-1090-203-12	Aviation Unit Maintenance Manual: Armament Subsystem, Helicopter: 7.62-mm Machine Gun/40-mm Grenade Launcher: M28A1 (Used on AH-1G Helicopter)
9-1090-203-12-1	Aviation Unit Maintenance Manual: Armament Subsystem, Helicopter: 7.62-mm Machine Gun/40-mm Grenade Launcher: M28A1E1 (Used on AH-1Q Helicopter)
9-1090-204-12	Aviation Unit Maintenance Manual for Mount, Multiarmament, Helicopter (Used on UH-1B or UH-1C Helicopters)
9-1090-206-12	Aviation Unit Maintenance Manual for Armament Subsystems, Helicopter: 20-mm Automatic Gun, XM97E1, Part No. 9324699 and XM97E2, Part No. 9324960
9-1090-207-13&P	Operator's Aviation Unit and Intermediate Maintenance Manual With Repair Parts and Special Tools

List Including Depot Maintenance Repair Parts and Special Tools for Rocket Management Subsystem, Inventory-Deployment, XM138, Part No. 934-106-002

System and M22 Guided Missile Launcher Helicopter Armament Subsystem)

Training Circulars (TCs)

- | | |
|-------|--|
| 1-201 | Tactical Flight Procedures |
| 25-3 | Training Ammunition (Training Ammunition Guidelines) |

Graphic Training Aid (GTA)

- | | |
|-------|---|
| 1-4-2 | Send-A-Message (SAM) |
| | Graphic training aids are available from the local Training and Audiovisual Support Center. |

- | | |
|-----------------|---|
| 9-1270-220-13&P | Operator's Aviation Unit and Aviation Intermediate Maintenance Manual with Repair Parts and Special Tools List Including Depot Maintenance Repair Parts and Special Tools for Sight, Helicopter; Head-Up Subsystem, XM-76 |
| 9-6920-461-12 | Organizational Maintenance Manual: Guided Missile Flight Control Training Sets DX-43 and DX-44 (ENTAC Antitank Guided Missile |

Section III

COMMAND PUBLICATIONS

Command publications cannot be obtained through Armywide resupply channels. Determine availability by contacting the address shown. Field circulars expire three years from the date of publication unless sooner rescinded.

- | | |
|-------|--|
| 1-212 | Utility Helicopter, UH-60. December 1984. Commander, US Army Aviation Center, ATTN: ATZQ-ATB-O, Fort Rucker, AL 36362-5000 |
| 1-213 | Attack Helicopter, AH-1. September 1984. Commander, US Army Aviation Center, ATTN: ATZQ-ATB-O, Fort Rucker, AL 36362-5000 |

Field Circulars (FCs)

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| 1-211 | Utility Helicopter, UH-1. July 1984. Commander, US Army Aviation Center, ATTN: ATZQ-ATB-O, Fort Rucker, AL 36362-5000 |
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23 October 1986

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